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Volume 13, Numbers 22 and 23, and 24 are combined in this issue.

ERRATUM

SELECTED WATER RESOURCES ABSTRACTS
Volume 14, Number 1, January 1, 1981

The "Notice to Subscribers" printed on the inside front cover does not apply to this issue and is a printer's error.

This issue includes abstracts W81-00001 through W81-00250, as noted on the lower left of the front cover.

SELECTED WATER RESOURCES ABSTRACTS

A semimonthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

VOLUME 14, NUMBER 1
JANUARY 1, 1981

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Office of Water Research and Technology. The cumlative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

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SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

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10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

PREDICTION OF BASEFLOW FOR PIEDMONT WATERSHEDS,
Clemson Univ., SC. Water Resources Research Inst.
T. V. Wilson, and J. T. Ligon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-119091, Price codes: A04 in paper copy, A01 in microfiche. Report No 80, November, 1979. 47 p, 14 Fig, 4 Tab, 4 Ref, 1 Append. OWRT-A-034-SC(1).

Descriptors: *Base flow, *Watersheds, *Mathematical models, *Forecasting, *Excess water(Soils), Moisture uptake, Moisture content, Base runoff, Groundwater discharge, Groundwater flow, Groundwater runoff, Flow, Drainage divides, Basins, Drainage systems, Computer models, Statistics, Statistical methods, Soil moisture, Model studies.

Ability to accurately predict baseflow rates under adverse weather conditions would be beneficial in systems planning for water supplies, pollution dispersion and removal, and recreational facilities. Four Piedmont watersheds and one Sandhill watershed, all unregulated flow, were selected for this study, which used a previously-developed baseflow model to estimate daily baseflow regimes for Piedmont watersheds. Two factors that appeared to give most trouble were (1) the lack of representative watershed precipitation data, and (2) the inability to use simple relationships to estimate surface runoff (which was not part of baseflow). The watersheds were divided into upper and lower zones based on the approximate depth to the water table. Using the nearest available precipitation data, estimated daily evapotranspiration rates, estimated surface runoff, and root zone soil moisture storage capacity, a daily soil moisture balance was used to calculate excessive soil moisture (EXSM); water assumed to contribute to saturated water storage and ultimate baseflow. All baseflow was assumed to be derived from EXSM. A simplified approach permitted the many variable watershed characteristics to do the integrating, and gave results that were reasonably good estimates of baseflow. (Zielinski-IPA)
W81-00197

2B. Precipitation

WEATHER FORECAST NEEDS FROM THE VIEWPOINT OF HYDROLOGY,
Geological Survey, Reston, VA. Water Resources Div.
D. M. Thomas, and T. J. Buchanan.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO. 80225, Paper copy $1.00, Microfiche $3.50. Geological Survey Open-File Report 80-754, 1980. 10 p, 6 Ref.

Descriptors: *Weather forecasting, *Hydrology, *Meteorology, *Flood forecasting, Reservoir operation, Reliability, Water supply, Water quality, Acid rain.

Hydrologists now depend on directly observed data in their forecasting and only infrequently use meteorological forecasts. Case studies show how reliable meteorological forecasts could be beneficial in flood and drought situations. Hydrologists need meteorological forecasts that recognize spatial variability, that are unbiased, and that have a specified degree of uncertainty. (USGS)
W81-00070

FIELD SITE DIRECTION OF PREPARATORY OBSERVATION FOR DETERMINING EFFECTIVENESS OF PROGRAM OF APPLIED WEATHER MODIFICATION IN THE CANARY ISLANDS,
AIRAO, Inc., Pagosa Springs, CO.
A. H. Schnell.
Completion Report prepared for Water and Power Resources Services, December 12, 1979. 85 p, 9 Ref, 3 Append. 0-07-85-V0031.

Descriptors: *Weather modification, *Climatology, *Meteorological data, Cloud cover, *Islands, Measurement, Dropwise condensation, Artificial precipitation, *Cloud seeding, Meteorology, Precipitation(Atmospheric), Rain, Storms, Water supply, Weather, Clouds, Convections, Nucleation, Weather patterns, Radar, Instrumentation, Remote sensing, *Canary Islands.

This report describes work conducted during the period of December 1979 through July 1980 on field site direction of preparatory observation for determining the effectiveness of a program on applied weather modification in the Canary Islands. Work carried out during this period consisted of observation of small convective systems within the sea of clouds over the Canarian Archipelago, using ground-based radar and airborne instrumentation and cloud condensation nuclei counter and simple drop-recording equipment. These observations fell under a preliminary studies phase. The three basic cloud types that were identified were warm sea clouds, warm orographic clouds, and cold clouds. The limited number of case studies obtained and the numerous observations made during the course of this project seemed to suggest that, for eventual future programs of Applied Weather Modification, especially over the eastern province of the Canary Archipelago, use of materials and techniques to enhance vertical development of isolated cells should be handled with extreme caution. A number of other recommendations related to potential weather modification activities were presented. (Zielinski-IPA)
W81-00096

STANDARD INTENSITY CURVES FOR RAINFALL OF SHORT DURATION (STANDAARD INTENSITEITSKROMMES VIR REENVAL VAN KORT DUURTES),
Bruinette, Kruger, and Stofberg, Johannesburg (South Africa).
W. M. Van Heerden.
The Civil Engineer in South Africa (Johannesburg), Vol 20, No 10, p 261-267, 1978. 11 Fig, 1 Tab, 12 Ref.

Descriptors: *Rainfall intensity, *Duration curves, *Frequency curves, *Classification, Precipitation(Atmospheric), Rates, Meteorology, Precipitation intensity, Mapping, Geolographical regions, Evaluation, Time, Time series analysis, Mathematical studies, Gaging stations, Data collections, Rating curves, *South Africa.

Eight sets of rain intensity-duration-return period curves applicable any place in South Africa are grouped according to intensities. The rainfall events with durations of 5 to 60 minutes, with a point value of 120 minutes, are given on the x-axis and the intensities are given by the values on the y-axis. Rainfall data from sixty-two gaging stations can be used to establish the class of the intensity or one of the existing methods used for intensity determination may be employed. The eight classes of intensities were derived from data previously reported in the literature and the distribution of intensities in relation to duration and frequency is applicable to rainfall analysis in the U.S. and other countries. (Sidney-IPA)
W81-00208

2C. Snow, Ice, and Frost

PRELIMINARY BATHYMETRY OF MC CARTY FIORD AND NEOGLACIAL CHANGES OF MC CARTY GLACIER, ALASKA,
Geological Survey, Tacoma, WA. Water Resources Div.
A. Post.
Geological Survey Open-File Report 80-424, 1980. 4 Sheets.

Descriptors: *Bathymetry, *Glaciers, *Alaska, *Glacial drift, *Icebergs, Glacial sediments, Fjords, Scour, Dating, Glaciology, Hydrography, Maps, Profiles, *McCarty Glacier(AK), *McCarty Fiord(AK).

Preliminary bathymetry (at 1:20,000 scale) and other scientific studies of McCarty Fiord, Alaska, Conducted by the Research Vessel Growler in 1978, showed this 15 mile-long waterway to be a narrow, deeply scoured basin enclosed by a terminal-moraine shoal. This valley was formerly filled by McCarty Glacier, which began a drastic retreat shortly after 1909; the glacier reached shallow water at the head of the fiord around 1960. The relative rate of retreat in deep water and on land is disclosed by the slower melting of stagnent ice left in a side valley. Soundings and profiles show the main channel to extend to a depth as great as 957 feet and to have the typical 'U' shape of a glacier-eroded valley; since the glacier's retreat, sediments have formed a nearly level deposit in the deepest part of the fiord. Old forest debris dated by carbon-14 indicates that a neoglacial advance of the glacier began before 3,395 years B.P. (before present); by 1,500 B.P. the glacier filled most of the fiord, and before the glacier culminated its advance around 1860, two glacier-dammed lakes were formed in side valleys. (USGS)
W81-00056

PRELIMINARY BATHYMETRY OF AIALAK BAY AND NEOGLACIAL CHANGES OF AIALIK AND PEDERSON GLACIERS, ALASKA,
Geological Survey, Tacoma, WA. Water Resources Div.
A. Post.
Geological Survey Open-File Report 80-423, 1980. 1 Sheet.

Descriptors: *Bathymetry, *Glaciers, *Alaska, *Glacial drift, *Icebergs, Glacial sediments, Fjords, Scour, Dating, Glaciology, Hydrography, Maps, Profiles, *Aialik Bay(AK), Aialik Glacier(AK), Pederson Glacier(AK).

Preliminary bathymetry (at 1:20,000 scale) and scientific studies of Aialik Bay, Alaska, by the Research Vessel Growler in 1978 disclose that the head of the bay consists of a deep basin enclosed by a terminal-moraine shoal. A much smaller basin, into which Aialik Glacier discharges icebergs, is located west of two islands and a submarine ridge. Comparison of 1978 soundings with U.S. Coast and Geodetic Survey (now National Oceanic and Atmospheric Administration) data obtained in 1912 shows shoaling of about 64 feet in the deepest part of the small basin nearest the glacier and of about 40 feet in the large basin. The time of retreat of Aialik Glacier from the moraine bar is unknown; a faint 'trimline' is still visible in the forest on the east side of the fiord, and a carbon-14 date suggests the retreat could have taken place as recently as 1800. The time of Aialik Glcier's neoglacial advance to the moraine is unknown. Pederson Glacier, which terminates in part in a tidal lagoon or lake, has retreated about 0.90 mile from a moraine judged by Grant and Higgins to have been in contact with the ice about 1896. (USGS)
W81-00057

WATERSHED INFORMATION SYSTEM,
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
For primary bibliographic entry see Field 7B.
W81-00081

PRELIMINARY BATHYMETRY OF BLACKSTONE BAY AND NEOGLACIAL CHANGES OF BLACKSTONE GLACIERS, ALASKA,
Geological Survey, Tacoma, WA. Water Resources Div.
A. Post.
Geological Survey Open-File Report 80-418, 1980. 2 Sheets.

Descriptors: *Bathymetry, *Glaciers, *Alaska, *Glacial drift, *Icebergs, Glacial sediments, Fjords, Scour, Dating, Glaciology, Hydrography, Maps, Profiles, *Blackstone Bay(Alaska).

Preliminary bathymetry (at 1:20,000 scale) and scientific studies of Blackstone Bay Alaska, by the Research Vessel Growler in 1978 disclose that the head of the bay consists of two basins separated by

Willard Island and a submarine ridge. Both basins are closed on the north by terminal-moraine bars where Blackstone Glacier and its tributaries terminated as recently as about A.D. 1350; a carbon-14 date of 580 years before present on Badger Point, and old trees farther up the bay, disclose that the glaciers retreated to two narrow inlets at the head of the bay before 1400. The inlets were still glacier-covered until at least 1909. Glaciers in both inlets have continued to retreat; at present they terminate at the head of tidewater, where they discharge small icebergs. Only relatively thin sediments have accumulated in the eastern basin south of the terminal-moraine bar, and most of the bottom is hard and irregular as disclosed by soundings and profiles. The northern part of Blackstone Bay is very deep; at more than 1,100 feet below sea level a large, level accumulation of sediment is present which is presumably as much as 1,000 feet deep and has been accumulating since late Pleistocene glaciers retreated. (USGS)
W81-00138

PRELIMINARY BATHYMETRY OF NORTHWESTERN FIORD AND NEOGLACIAL CHANGES OF NORTHWESTERN GLACIER, ALASKA,
Geological Survey, Tacoma, WA. Water Resources Div.
A. Post.
Geological Survey Open-File Report 80-414, 1980. 2 Sheets.

Descriptors: *Bathymetry, *Glaciers, *Alaska, *Glacial drift, *Icebergs, Glacial sediments, Fjords, Scour, Dating, Glaciology, Hydrography, Maps, Profiles, *Northwestern Glacier(AL), *Northwestern Fiord(AL).

The first preliminary bathymetry (at 1:20,000 scale) and other scientific investigations of Northwestern Fiord, Alaska, were conducted by the Research Vessel Growler in 1978, disclosing this 10.5-mile-long branched waterway to be a deep basin enclosed by a terminal-moraine shoal. The basin was formerly filled by Northwestern Glacier, which began a drastic retreat around 1909 and reached the head of the main arm around 1960. Soundings and profiles show the main channel to be as much as 970 feet deep and to have the typical U shape of a severely glacially eroded valley; since the glacier's retreat, sediments have formed nearly level deposits in the deepest reaches, while the rest of the basin has a hard, rocky bottom. Preneoglacial forest debris dated by carbon-14 indicates Northwestern Glacier to have advanced into the fiord prior to 1,385 years before present (B.P.); a branch glacier evidently advanced into forest 1,635 years B.P. The combined glaciers from several arms culminated on the present terminal-moraine shoal around 1894. (USGS)
W81-00140

2D. Evaporation and Transpiration

WEATHER AND EVAPOTRANSPIRATION STUDIES IN A SALTCEDAR THICKET, ARIZONA,
Geological Survey Tucson, AZ. Water Resources Div.
T. E. A. van Hylckama.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $4.00.

Descriptors: *Evapotranspiration, *Tamarisk, *Phreatophytes, *Hydrologic budget, *Water utilization, Analytical techniques, Vegetation, Riparian plants, Consumptive use, Water loss, Hydrologic cycle, Environmental effects, Climatology, Soil moisture, Transpiration, Evaporation, Soil-water-plant relationships, Lysimeters, Arizona, Aerodynamic resistance, Stomatal Resistance.

It is often assumed that flood-plain and riparian vegetation transpires large quantities of water. Because of the large area it occupies in the southwestern United States, saltcedar is especially suspected of doing so. The quantities of water transpired from small areas can be measured directly with evapotranspirometers or lysimeters, but can be determined indirectly faster and more efficiently if valid correlations can be established between such readily measureable ambient inputs as radiation and windspeed and the reaction of plants to such inputs. Observations of environmental conditions and of water use by saltcedar (Tamarix chinensis) were made over a 6-year period. Rough estimates of water use can be made for periods of a month or longer by the use of a few simple methods involving only a few ambient parameters. For precise prediction of water use much more elaborate measurement and recording equipment is necessary, and aerodynamic and stomatal resistances must be taken into account. Although there may be times and locations where transpiration rates are high, there are reasons to believe that vegetation management with the goal of slavaging transpiring water may often not be economically warrented. (USGS)
W81-00157

2E. Streamflow and Runoff

METHODS OF LOW FLOW PREDICTIONS FOR SMALL GEORGIA STREAMS,
Georgia Inst., of Tech., Atlanta.
J. R. Wallace, G. N. Day, W. R. Howard, Jr., and K. J. Wiederkhr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-109779, Price codes: A08 in paper copy, A01 in microfiche. Environmental Resources Center, Georgia Institute of Technology Report, ERC 03-80, April 1980, 144 p, 55 Fig. OWRT-B-130-GA(1), 14-34-0001-7114.

Descriptors: *Low flow, Droughts, *Runoff forecasting, *Georgia, Streams, *Model studies, Small watersheds, Low flow predictions, Ungaged streams, Waste assimilative capacity, Watershed simulation, Precipitation models.

Low flow in Georgia streams was estimated for use in determining waste assimilative capacity, the amount of oxygen-consuming waste that can be released into a stream without violating water quality standards. Low flow data are also needed for allocation of this resource during times of scarcity. Several approaches to the analysis and prediction of low flow were examined. The first used the concept of a deterministic watershed simulation model to estimate stream flow. The model developed was used to simulate six watersheds in Georgia, two in the mountains, two in the Piedmont and two in the Coastal Plain. Simulated low flows were considerably more accurate for some watersheds than for others. Another approach was statewide estimation of low flow based on data at more than 150 continuous and partial record gaging stations. Zones with similar 7-day average low flow were outlined for different return periods. The potential for using the correlation between precipitation and low flow as a method for predicting low flow was investigated. It was concluded that stream flow-precipitation correlation methods hold promise as a technique for estimating low flows. Analysis of the techniques examined in this investigation led to the conclusion that maps showing zones of average low flow represent best currently available method for estimating low flow in Georgia streams. It is recommended that these maps be used when estimates of low flow are needed on ungaged streams.
W81-00005

FREQUENCY OF AGRICULTURAL AND FOREST DROUGHT IN NEW HAMPSHIRE: 1926 - 1975,
Northeastern Forest Experiment Station, Durham, NH.
For primary bibliographic entry see Field 7B.
W81-00034

LIMITED CONFIDENCE IN CONFIDENCE LIMITS DERIVED BY OPERATIONAL STOCHASTIC HYDROLOGIC MODELS -- COMMENTS,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. Stedinger.
Journal of Hydrology, Vol 47, p 377-380, 1980. 8 Ref. OWRT-A-085-NY(2).

Descriptors: *Streamflow, *Model studies, *Synthetic hydrology, *Stochastic processes, *Statistical methods, Hydrology, River forecasting, Mathematical studies, Sampling, Probability, Statistical models, Time series analysis, Optimization, Statistics, Estimating, Evaluation.

The purpose of this commentary paper was to explain why the results of a study reported earlier by Klemes and Bulu (Journal of Hydrology, Vol 42, p 9-22, 1970) demonstrating that standard procedures for synthetic streamflow generation fail to generate flows which capture the likely range of the sample moments of future streamflow sequences, should have been expected. The Klemes-Bulu study showed that, in particular, the means and standard deviations of monthly flows calculated using the second, third, and fourth 25-year streamflow segments (of four 25-year segments of a 100-year streamflow record) too frequently fell outside 95% confidence intervals. Monthly streamflow models used in the earlier study that reproduce only between month correlations of flows in nearby months often underestimate the year-to-year correlations of annual flows, and for a given month, the variance of the difference between a sample mean and its modeled value is greater than the modeled variance of the generated means used to construct the confidence intervals. A reply prepared by Klemes and Bulu appears in the same issue (Journal of Hydrology, Vol 47, p 381-383, 1980), clarifying this modeling presentation approach in explanation to these comments. (Zielinski-IPA)
W81-00047

AQUIFER RECHARGE FROM THE 1969 AND 1978 FLOODS IN THE MOJAVE RIVER BASIN, CALIFORNIA,
Geological Survey, Menol Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W81-00052

EFFECTS OF AGRICULTURAL DRAINAGE DEVELOPMENT ON BENTHIC INVERTEBRATES IN UNDISTURBED DOWNSTREAM REACHES,
Minnesota Univ., St. Paul.
For primary bibliographic entry see Field 5C.
W81-00103

CONSERVATION AND FLOW MAINTENANCE DURING DROUGHT,
Rutgers - The State Univ., Brunswick, NJ. Water Resources Research Inst.
W. Whipple.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 103-116, 1979. 5 Fig, 5 Ref.

Descriptors: *Water conservation, *Droughts, *Flow rates, *Environmental effects, Water policy, Planning, Urbanization, Forecasting, Water rights, Water supply, Water resources development, Runoff, Recharge, Groundwater, Hydrology.

Water supply planning, water quality planning, and comprehensive basin planning are needed to prevent further erosion of environmentally necessary flows during periods of drought. Water supply planners and managers are apt to consider the total quantity of water carried by a stream at any given time to be available for use without consideration of the maintenance of environmental streamflow needs. To combat this situation a comprehensive approach is needed involving tradeoffs between reductions in customer demand, maintenance of environmental stream flow needs, and levels of capital investment in improved facilities. Present Western water laws make this type of approach difficult and appropriate Eastern water laws do not exist. Too often overt conflicts are avoided by making unacknowledged over-appro-

priations. While the establishment of minimum flows is important, it is, however, unrealistic to insist that these flows be maintained under any conceivable conditions. Streams will recover rapidly in most cases if they have zero flow for a few days. Extended zero flow would cause more serious environmental damage. Projections of future hydrology indicate that with development total water available from surface runoff and ground supplies will increase, but more of it will be as flood flows. Natural drought flows and groundwater recharge will be reduced. These forecasts must be considered when planning for future water supplies. (See also W81-00160) (Seigler-IPA)
W81-00172

THE NWS EXTENDED STREAMFLOW PREDICTION TECHNIQUE,
National Weather Service, Silver Spring, MD.
D. C. Curtis, and J. C. Schaake.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 182-195, 1979. 2 Fig, 1 Tab, 17 Ref.

Descriptors: *Forecasting, *Model studies, *Mathematical models, Streamflow forecasting, Channel flow, Routing, River forecasting, Low-flow frequency, Regression analysis, Droughts, Hydrologic data, Hydrology, Evapotranspiration, Computer models.

The Extended Streamflow Prediction Model (ESP) is a stochastic dynamic model using conceptualizations of catchment hydrology with historical data to produce probabilistic estimates of future streamflows. ESP has a more physically based approach than common regression methods through the use of the conceptual hydrologic model. ESP provides for a more complete description of watershed physics and a probabilistic analysis of model outputs. The model eliminates many of the weaknesses of regression analysis type techniques and is more flexible. ESP utilizes data from the National Weather Service River Forecast System including mean areal precipitation, mean areal temperature, and mean areal evapotranspiration. There are three major hydrologic and hydraulic computational elements, soil moisture accounting, snow accumulation and ablation, and channel routing. Data required other than program control and option information include hydrological model parameters, initial basin conditions, and representative future time series inputs. Two examples given of the use of ESP are the California drought of 1976-1977 and the northern Virginia drought of 1977. Areas for future research include optimal state estimation, short and long term weather forecasts, model error analysis, model output analysis, and analysis of economic impact. (See also W81-00160) (Seigler-IPA)
W81-00182

PREDICTION OF BASEFLOW FOR PIEDMONT WATERSHEDS,
Clemson Univ., SC. Water Resources Research Inst.
For primary bibliographic entry see Field 2A.
W81-00197

SHIFTING LEVEL MODELLING OF HYDROLOGIC SERIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. D. Salas, and D. C. Boes.
Advances in Water Resources, Vol 3, No 2, p 59-63, June, 1980.

Descriptors: *Hydrologic data, *Computer models, *Flow measurement, *Time series analysis, *Stochastic processes, Low-flow frequency, Nonuniform flow, Correlation analysis, Application methods, Simulation analysis, Rivers.

The potential use of shifting level models of time series hydrologic data is discussed, and deficit and run properties are compared with those of certain autoregressive (ARMA) models. Though still in a developmental stage, the shifting level model is better able to reproduce droughts, floods, and other natural, abrupt shifts in streamflow for long-term historical records. Potential applications include modelling the hydrology of equatorial lakes, of sea-current effects along equatorial coastlines, and hydrologic changes related to natural disturbances such as forest fires, earthquakes, landslides and changes in land use. The model is based on a sequence of random variables whose values represent the different levels of streamflow over random time spans. The correlation function of this model is composed of a low-frequency component due to the random shifts of level. When simplified, the correlation structure is identical to that of the ARMA model. In a comparison of shifting level and ARMA models, based on annual flows of the Niger River, it was found that mean maximum accumulated deficit, mean longest negative run length, and mean largest negative run sum for both models are similar. However, variances for the shifting level model are greater than the corresponding variances of the ARMA model. (Titus-FRC)
W81-00207

THE ORGANIZATIONAL PATTERN OF BALTIC MARINE SCIENCE,
Havsfiskelaboratoriet, Lysekil (Sweden).
B. I. Dybern.
Ambio, Vol 9, No 3-4, p 187-193, 1980.

Descriptors: *Organizations, *Research and development, *Baltic Sea, Marine biology, Oceanography, Oceans, Administrative agencies, International commissions, Water pollution control, Research facilities, Conferences.

International cooperative bodies which are dealing with Baltic marine problems are named and a brief description of the functions of each body is given. Bodies confined to the Baltic Sea area are the International Baltic Sea Fishery Commission, Committee for the Gulf of Bothnia, Conferences of Baltic Oceanographers, Baltic Marine Biologists, and the ICES/SCOR Working Group on the Study of Pollution of the Baltic. Bodies covering a larger area than the Baltic but with sub-bodies for the Baltic are the International Council for the Exploration of the Sea, International Hydrological Program of UNESCO, Council for Mutual Economic Assistance, Scientific-Technological Cooperation Committee between Finland and the USSR, and the Scientific Committee on Oceanic Research. The Nordic Council, Nordic Council of Ministers, Nordic Council for Marine Biology, Nordic Council for Physical Oceanography, Commission for Economic and Technological-Scientific Cooperation between Denmark and the USSR, and the Soviet-Swedish Committee on Economic, Scientific and Technological Cooperation have wider coverage than the Baltic but have great impact on Baltic research. About half the approximately 350 scientists (mostly biologists and oceanographers) who devote most of their time to Baltic marine science work for one or more of these bodies. Each year, there are 20-25 international meetings on the Baltic. There are about 25 marine research institutions along the Baltic coasts, and about 20 research vessels working on the sea. The author urges that the rigidity of the present structure be relaxed and many scientists allowed to give more of their time to science rather than to organization. (Baker-FRC)
W81-00209

2F. Groundwater

AQUIFER RECHARGE FROM THE 1969 AND 1978 FLOODS IN THE MOJAVE RIVER BASIN, CALIFORNIA,
Geological Survey, Menol Park, CA. Water Resources Div.
A. Buono, and D. J. Lang.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO. 80225, Paper copy $5.00, Microfiche $4.00. Geological Survey Open-File Report 80-207 (WR(), April 1980. 25 p, 11 Fig, 3 Tab, 14 Ref.

Descriptors: *Groundwater recharge, *Floods, *California, *Streamflow, *Water lvels, Aquifers, Water wells, Flood recurrence interval, Precipitation excess, Surface runoff, Peak dicharge, Flood damage, Hydrographs, *Mojave River basin(CA), *San Bernardino County(CA).

The Mojave River basin, a high desert area in southwestern San Bernardino County, Calif., received 2.3 times the normal annual precipitation during the 1969 and 1978 water years. Precipitation in the mountainous upper part of the watershed is the primary source of flow in the Mojave River. The resulting floods had an instantaneous peak discharge of 18,000 cubic feet per second in 1969, about 100 miles downstream, representing the maximum flood-recurrence interval in the basin of 30 years. The instantaneous peak measured during the 1978 floods at Deep Creek represented the maximum flood-recurrence interval in the basin of 20 years. A comparison of the hydrologic data for the 1969 and 1978 flood periods indicates that although more precipitation occurred in 1969, more recharge occurred in 1978. The factors that caused the greater recharge were: (1) The more evenly distributed precipitation from December 1977 to April 1978, allowing for more uniform surface-water runoff in the Mojave River; (2) the dams constructed in the upper basin after 1969 which regulated floodflow peaks and allowed more water to stay in the basin; and (3) the lower water level in the aquifer in 1978, which made more space available to store the recharge water. Total recharge resulting from the floods is estimated to have been 245,000 acre-feet in the 1969 water year and 282,000 acre-feet in 1978. (USGS)
W81-00052

SURFICIAL GEOLOGY OF PENNELLVILLE QUADRANGLE, OSWEGO COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W81-00055

A QUASI THREE-DIMENSIONAL FINITE-DIFFERENCE GROUNDWATER FLOW MOEL WITH A FIELD APPLICATION,
Maryland Geological Survey, Towson.
G. Achmad, and J. M. Weigle.
Report of Investigations No 33, 1979. 57 p, 22 Fig, 1 Tab, 19 Ref, 4 Append.

Descriptors: *Model studies, *Groundwater, *Flow, *Mathematical models, *Simulation analysis, Aquifers, Aquicludes, Leakage, Aquifer systems, Pumping, Water level fluctuations, Observation wells, Hydrographs, Maryland, Computer programs, *Quasi three-dimensional flow, Finite difference, Worcester County(MD).

This report describes a quasi three-dimensional model which was constructed from a sequence of aquifer areal-flow equations coupled by leakage terms representing flow through the confining beds. In simulating a four-aquifer system in northeastern Worcester County, Md., the model was able to reproduce the hydrographs of several observation wells with differences of less than 1 foot for 60 percent and less than 5 feet for 95 percent of the data points. The computer program of the model is given in the appendices. (USGS)
W81-00058

PLAN OF STUDY FOR THE NORTHERN ATLANTIC COASTAL PLAIN REGIONAL AQUIFER SYSTEM ANALYSIS,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 6A.
W81-00068

FRESHWATER RESOURCES OF BIG PINE KEY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2L.
W81-00069

GROUND WATER FLOW SYSTEMS IN THE PHOSPHATE SEQUENCE, CARIBOU COUNTY, IDAHO,
Idaho Univ., Moscow. Water Resources Research Inst.
G. V. Winter.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-113078, Price codes: A07 in paper copy, A01 in microfiche. Technical Report, March, 1980. 120 p, 45 Fig, 14 Tab, 32 Ref, 5 Append. OWRT-C-7651(No 7253)(5).

Descriptors: Groundwater, Groundwater availability, *Geologic control, *Phosphates, *Geologic formations, Subsurface waters, Idaho, Groundwater resources, *Groundwater movement, Groundwater barriers, *Hydrogeology, Phosphorus, Phosphorus compounds, Geology, Groundwater basins, Hydrology, Rocks, *Caribou County(ID).

Potential impact of phosphate mining on the hydrogeology/hydrology of an area can only be evaluated if the capability of the formations to support groundwater flow systems is understood. A study was conducted to evaluate this capability in the study area, and to test the hypothesis that similar systems exist within the phosphate sequence of geologic units (Dinwoody, Phosphoria, and Wells Formations) throughout a large area of the Western Phosphate Field of Caribou County, Idaho. It was concluded that the formations comprising the phosphate sequence exhibited similar hydrogeologic characteristics throughout the study area. Support for major groundwater flow systems were noted for the upper and lower members of the Dinwoody and Wells Formations. Groundwater flow systems above the Phosphoria Formation were separated from those below the Formation, causing the upper flow systems to be local in extent and the lower flow system to be regional. Findings for the presence/absence of other groundwater flow systems were included. The groundwater information derived from this study should be transferable to other areas where this phosphate sequence is present. Minor variations of the flow system characteristics may occur with variations in physical composition of the formations. (Zielinski-IPA)
W81-00072

A GEOCHEMICAL AND HYDROLOGICAL INVESTIGATION OF GROUNDWATER RECHARGE IN THE ROSWELL BASIN OF NEW MEXICO: SUMMARY OF RESULTS AND UPDATED LISTING OF TRITIUM DETERMINATIONS,
New Mexico Inst. of Mining and Technology, Socorro.
G. W. Gross, and R. N. Hoy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-114647, Price codes: A07 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, New Mexico State University, Las Cruces. Report No. 122, April 1980. 141 p, 3 Fig, 12 Ref, 1 Append. OWRT-A-055-NMEX(4).

Descriptors: *Groundwater recharge, *Tritium, *Hydrologic budget, *Basins, New Mexico, Hydrogen radioisotopes, Deuterium, Radioactivity, Groundwater, Recharge, Natural recharge, Infiltration rates, Inflow, Precipitation(Atmospheric), Geochemistry, Groundwater basins, Stochastic processes, *Roswell basin(NM), Surface-groundwater relationships.

Different approaches were used to study recharge and flow patterns in the Roswell, New Mexico, artesian basin. Isotope determination for tritium, deuterium, and oxygen-18 were made as a function of time and space. Observation well levels, springflow, and precipitation were analyzed by stochastic/numerical approaches. Also, a hydrogeologic survey was made of representative springs in the recharge zone on the basin western flank. An updated listing of tritium activity in precipitation, springs, surface runoff, and subsurface water from over 120 sampling sites in the basin covers 117 pages of the report, and supersedes and continues that reported earlier by the same investigators. Detailed interpretation of the tritium data, while remaining to be done, is expected to yield answers to questions on the effect of basin pumpage on deeper (older) water leakage, on the residence time of groundwater in the southern (Artesia) part of the basin, and on the role of the structure zones in recharge to the Principal Aquifer. The accumulated evidence indicated that the contribution of the Principal Intake Area to the basin recharge was overestimated in the past. Substantial deep leakage contributions from the basin western flank must be included to account for the basin groundwater budget. (Zielinski-IPA)
W81-00078

LINEAR SYSTEM MODELS FOR REGIONAL AQUIFER EVALUATION STUDIES,
Parsons, Brinckerhoff, Quade and Douglas, Inc., New York.
C. T. Bathala, A. R. Rao, and J. A. Spooner.
Water Resources Research, Vol 16, No 2, p 409-422, April 1980. 11 Fig, 9 Tab, 17 Ref. OWRT-C-3277(No 3713)(16) and C-6106(No 5213)(13).

Descriptors: *Aquifer characteristics, *Mathematical models, *Groundwater movement, Hydraulic properties, Model studies, Equations, Storage coefficient, Transmissivity, Surface-groundwater relationships, Pumping, Drawdown, Water levels, Water wells, Well spacing, *Linear systems, Aquifer-stream systems, Regional aquifer systems, Sensitivity analysis.

A generalized linear system model was formulated to analyze several types of groundwater flow problems. An iterative procedure was developed to predict aquifer response due to pumping demand by considering the analytical relationships governing the groundwater flow. Historical pumping rates, groundwater levels, stream stages, and estimated storage coefficients were used as inputs to the model. The model outputs were the aquifer transmissivities and the predicted groundwater levels. The sensitivity of the model to variations in the estimated storage coefficients was investigated. The technique was illustrated by considering a realistic but hypothetical regional aquifer system, and the results were demonstrated to be satisfactory. The technique is insensitive even to large errors in the estimated storage coefficients. The number of simultaneous equations to be solved and hence the computational time required are much smaller than those encountered un the conventional numerical models of aquifer systems. Aquifer transmissivity and storage coefficient values are computed as a part of this procedure, therefore, expensive pumping tests that are usually required to estimate these aquifer parameters are not necessary in this technique. (Visocky-ISWS)
W81-00105

POTENTIOMETRIC SURFACE OF FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT AND ADJACENT AREAS, MAY 1979,
Geological Survey, Tampa, FL. Water Resources Div.
R. M. Wolansky, L. R. Mills, W. M. Woodham, and C. P. Laughlin.
Geological Survey Open-File Report 79-1255, 1979. 1 Sheet.

Descriptors: *Maps, *Aquifers, *Water levels, *Potentiometric level, *Florida, Water wells, Water utilization, Irrigation, Water level fluctuations, *Floridan aquifer, Southwest Florida Water Management.

A May 1979 potentiometric-surface map depicts the annual low water-level period. Potentiometric levels declined 4 to 21 feet between September 1978 and May 1979, in the citrus and farming sections of southern Hillsborough, northern Hardee, southwestern Polk, northwestern DeSoto, and Manatee Counties. Water levels in these areas are widely affected by pumping for irrigation and have the greatest range in fluctuations. Water-level declines ranged from 0 to 6 feet in coastal, northern, and southern areas of the Water Management District. Generally potentiometric levels were higher than previous May levels due to heavy rains in April and May. In parts of Hillsborough, Pasco, and Pinellas Counties, May 1979 potentiometric levels were 18 feet higher than those of September 1978. (USGS)
W81-00141

SEASONAL AND ANNUAL VARIATIONS IN THE POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN DUVAL COUNTY, FLORIDA, 1960-77,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W81-00142

GROUND WATER IN OSCEOLA COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W81-00143

CONFIGURATION OF THE TOP OF THE HIGHLY PERMEABLE DOLOMITE ZONE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W81-00144

GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1980,
Geological Survey, Salt Lake City, UT. Water Resources. Div.
L. R. Herbert.
Utah Division of Water Resources Cooperative Investigations Report No 19, 1980. 72 p, 39 Fig, 3 Tab, 2 Ref.

Descriptors: *Groundwater resources, *Utah, *Aquifers, *Withdrawal, *Water level fluctuations, Water quality, Water wells, Water utilization, Water supply, Irrigation, Hydrogeology, Water table, Potentiometric level, Grondwater recharge, Hydrologic data, Precipitation(Atmospheric), Surface-groundwater relationships, Hydrographs, Maps.

This is the seventeenth in a series of annual reports that describe groundwater conditions in Utah. The estimated total withdrawal of water from wells in Utah in 1979 was about 860,000 acre-feet--about 31,000 acre-feet more than in 1978 and 73,000 acre-feet more than the average annual withdrawal during 1969-78. The increase in withdrawal from the amount reported for 1978 was due primarily to increases in withdrawal for public supply. Total withdrawal for public supply in 1979 was about 162,000 acre-feet, which is 33,000 acre-feet more than reported for 1978. Withdrawal for irrigation was 567,000 acre-feet, an increase of 5,000 acre-feet. The quantities closely related to local climatic conditions. Precipitation in 1979 was below average in most of Utah (Natio of water withdrawn from wells are nal Oceanic and Atmospheric Administration, 1980). Of the 33 stations for which graphs of cumulative departure from average annual precipitation are included in this report, 27 had below-average precipitation in 1979. This contributed most significantly to increased withdrawals from wells during 1979. The below-average precipitation in most parts of the State during 1979 resulted in local reduction in ground-water recharge as well as increased withdrawals from wells. This in turn resulted in a general decline of ground-water levels in many parts of the State from spring of 1979 to spring of 1980. Notable exceptions where rises occurred were in areas where local above-average runoff contributed greatly to the recharge of the groundwater reservoir. The total number of wells drilled during 1979, as indicated by well-drillers' reports filed with the Utah Division of Water Rights, was about 35 percent less than reported for 1978. The number of those wells 6 inches or more in diameter drilled for public supply irrigation, and industrial use was about 28 percent less than reported for 1978. (USGS)

W81-00150

GEOLOGIC AND HYDROLOGIC DATA FROM A TEST-MONITOR WELL AT FERNANDINA BEACH, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 4B.
W81-00151

HYDROLOGIC MONITORING PROGRAM IN ELDRIDGE-WILDE AND EAST LAKE ROAD WELL-FIELD AREAS, PINELLAS AND HILLSBOROUGH COUNTIES, FLORIDA, 1977 WATER YEAR,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 4B.
W81-00153

MAPS SHOWING GROUND-WATER CONDITIONS IN THE DOUGLAS BASIN AREA, COCHISE COUNTY, ARIZONA--1978,
Geological Survey, Tucson, Az. Water Resurces Div.
For primary bibliographic entry see Field 7C.
W81-00155

MAPS SHOWING GROUND-WATER CONDITIONS IN THE UPPER VERDE RIVER AREA, YAVAPAI AND COCONINO COUNTIES, ARIZONA--1978,
Geological Survey, Tucson, Az. Water Resources Div.
For primary bibliographic entry see Field 7C.
W81-00156

GROUND-WATER DATA FOR BILLINGS, GOLDEN VALLEY AND SLOPE COUNTIES, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 4B.
W81-00158

GROUND-WATER RESOURCES OF DICKEY AND LA MOURE COUNTIES, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 4B.
W81-00159

2G. Water In Soils

PREDICTING THE EFFECTS OF CHANGING WATER-TABLE LEVELS AND ASSOCIATED SOIL MOISTURE REGIMES FOR SOIL SURVEY INTERPRETATIONS,
Soil Survey Inst., Wageningen (Netherlands).
J. Bouma, P. J. M. de Laat, A. F. van Holst, and Th. J. van de Nes.
Soil Science Society of America Journal, Vol 44, No 4, p 797-802, July-August 1980. 7 Fig, 1 Tab, 14 Ref.

Descriptors: *Water table, *Soil moisture, *Computer models, *Evapotranspiration, Soil types, *Crop production, Unsaturated flow, Water level fluctuations, Grasses, Hydraulic conductivity, Root zone, Depth, Retention, Mapping, Soil survey data.

A one-dimensional computer model for simulating the soil moisture regime was used to calculate evapotranspiration and equivalent productions of grass for six different soils. Input data consisted of rooting depths, moisture retention curves, and hydraulic conductivity curves. Physical boundary conditions were derived from climatic data and depths to water table. Average relative production was calculated for actual water table fluctuations and for lowered levels, thus simulating the effects of groundwater extraction. Productions for the six soils reacted quite differently to lowering of the water table. A classification was developed to characterize the different reactions. A SYMAP computer program was used to produce maps (which were based on soil maps) showing the effects in different soils to lowering of the water table. Storage of basic data on tape allows the production of many maps on demand for natural conditions and for conditions changed by man. Soil survey interpretation thus becomes a matter of offering many choices rather than a qualitative judgment based on actual conditions. The model can be used to express variability of mapping units on a soil map by simulating moisture regimes for the range of soil properties observed within the mapping unit. (Visocky-ISWS)
W81-00101

2H. Lakes

THE ROLE OF ZOOPLANKTON VERTICAL MIGRATION IN STRUCTURING THE PHYTOPLANKTON COMMUNITY,
New Hampshire Univ., Durham. Dept. of Zoology.
J. F. Haney, and C. L. Buchanan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-112633, Price codes: A05 in paper copy. Water Resource Research Center, University of New Hampshire, Research Report No 30, 1980. 84 p, 32 Fig, 13 Tab, 36 Ref. OWRT-A-044-NH (2), 14-31-0001-5029.

Descriptors: *Zooplankton, *Vertical migration, *Phytoplankton, *Regression analysis, *Distribution patterns, Aquatic animals, Model studies, Lakes, Community depth distribution, Model lake systems, Population depth control, Multiple regression analysis, *Daphnia, Arctic lakes, Light concentration, Food concentration.

Development of a model to predict the effectiveness of zooplankton grazing on phytoplankton requires knowledge of the factors which regulate the depth distribution of both communities. In this study, model lake systems (columns) were evaluated for their usefulness in the study of depth control of zooplankton populations. Simple linear regression and multiple regression analyses were employed to develop predictive models based on these studies under controlled laboratory conditions and in the field. Zooplankton depth regulation was further tested under continuous light in arctic lakes and ponds as well as in experimental columns. The influence of light and food concentration was examined with the experimental columns under controlled conditions. Food concentration strongly regulates the day-depth distribution of Daphnia populations. At high food densities the population mean depth approaches the surface waters and at low food levels the population is found in the deep water. This relationship was described by a linear regression equation. Vertical movements resulting from food changes were almost immediate, although differences were found between long-term and short-term responses. The relationship between temperature changes and population mean depth was also defined. Absolute light intensity was not an important regulator of day-depth and vertical migration in temperate or arctic zooplankton. However, the rate of evening migration in temperate zooplankton and the daytime displacement velocity of arctic zooplankton populations was closely correlated with the relative light change. Implications of these results to models of depth control and grazing by zooplankton are discussed.
W81-00021

HYDROLOGIC SETTING OF WILLIAMS LAKE, HUBBARD COUNTY, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
D. I. Siegel, and T. C. Winter.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $8.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-403, 1980. 56 p, 14 Fig, 6 Tab, 19 Ref.

Descriptors: *Hydrology, *Water balance, *Lakes, *Minnesota, *Model studies, Statistical methods, Glacial drift, Precipitation(Atmospheric), Evaporation, Groundwater, Surface waters, Discharge(Water), Flow characteristics, Water quality, Chemical analysis, Hydrographs, Data collections, *Williams Lake(MN), *Hubbard County(MN), *Surface-groundwater relationships.

The hydrology and geology of Williams Lake watershed was studied to evaluate the accuracy of various methods used to determine precipitation and evaporation in lake water-balance studies and to define a lake and ground-water system according to approaches suggested by theoretical modeling studies. Regression analysis between estimated and measured precipitation at the lake showed that the accuracy of regionalization techniques is dependent on the closeness of the data network to the lake. For individual storms, the average-value method was found to be better than either the weighted average or isohyetal methods of determining precipitation, but it was least accurate in estimating 14-day average precipitation. The amount of evaporation calculated by the mass-transfer method ranged from 2 to 7 inches per month from July to October 1978, depending on the method used to determine the mass-transfer coefficient. Test drilling indicated that 30 to 150 feet of sand and gravel overlies till in the Williams Lake watershed. A sand lens about 50 feet thick occurs within the till. The configuration of the water table and vertical-head gradients measured from July to December 1978 indicate that ground water moves into the lake from the south and east and moves from the lake into the ground-water reservoir to the west. Preliminary numerical models indicate that the sand lens within the till is effectively isolated from the flow system interacting with the lake and that both inseepage and outseepage were about 1.4 inches from mid-July to mid-October 1978. When estimated as a residual in a water balance, ground water showed a net outseepage only of 1.47 inches. (USGS)
W81-00050

THE EFFECTS OF USING GROUND WATER TO MAINTAIN WATER LEVELS OF CEDAR LAKE, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
R. S. McLeod.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-197593, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-23, April 1980. 35 p, 17 Fig, 4 Tab, 6 Ref.

Descriptors: *Lakes, *Water levels, *Effects, *Groundwater, *Wisconsin, Hydrogeology, Water level fluctuations, Flow characteristics, Aquifers, Seepage, Pumping, Recharge, Hydrologic budget, Water quality, Physical properties, Chemical analysis, Limnology, Cedar Lake(WI), Inflow, Water transfer.

Cedar Lake, a kettle lake with no surface inlet or outlet, was studied to evaluate the feasibility of maintaining water levels of lakes in the glaciated kettle moraine area of eastern Wisconsin by pumping ground water into them. A volume of water equivalent to that needed to raise the lake level 47 inches was pumped from the shallow aquifer system into Cedar Lake between February 1 and September 30, 1977. The water budget for the lake during this period indicated that approximately 90 percent of pumped water was either recycled from the lake to the well or otherwise lost as seepage from the lake. There were no identifiable changes in measured physical and chemical characteristics of lake water during the pumping period, nor were there identifiable changes in the number or makeup of the phytoplankton community. Differences in physical and chemical characteristics of lake water and ground water added to the lake probably were not great enough to cause changes within the lake. (USGS)
W81-00066

LIMNOLOGY OF LAGO LOIZA, PUERTO RICO,
Geological Survey, San Juan, PR. Water Resources Div.

For primary bibliographic entry see Field 5C.
W81-00067

ARCTIC INVESTIGATIONS OF SOME FACTORS THAT CONTROL THE VERTICAL DISTRIBUTIONS AND SWIMMING ACTIVITIES OF ZOOPLANKTON,
New Hampshire Univ., Durham. Dept. of Zoology.
C. L. Buchanan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-118267, Price codes: A06 in paper copy, A01 in microfiche. Ph.D. Dissertation, 1978. 103 p, 26 Fig, 9 Tab, 73 Ref. OWRT-A-0440NHL1), 14-31-0001-5029.

Descriptors: *Zooplankton, *Vertical migration, *Phytoplankton, Distribution patterns, Aquatic animals, *Community depth distribution, *Population depth control, *Daphnia magna, Arctic lakes, Diel cycle.

The vertical distributions and movements of zooplankton populations in arctic lakes and ponds were studied. Plexiglas columns, which were surrounded on four sides by a light tight chamber and exposed to natural light from above, were used to study the vertical distributions and movements in closer detail and to measure zooplankton swimming rates. Populations did not undergo diel vertical migrations under continuous light or under long day photoperiods with dark nights. Extreme temperatures depressed the population mean depth, and diel temperature fluctuations could cause vertical movements in pond and column populations. A diel cycle was observed in the swimming rates of zooplankton populations exposed to both continuous light and long day photoperiods, with highest rates in the afternoon and sometimes in the morning. The cycle of swimming activity appears to be based in an endogenous rhythm, and could cause a slight vertical migration in zooplankton populations when phototactic orientation cues were weak. Zooplankton were transferred north and south to different light cycles to test the dependence of the diel cycle of swimming activity upon light. High or low temperatures changed the absolute rate of swimming activity but apparently did not affect the timing of the diel cycle. The behavior of a temperate species, D. magna, which was imported from New Hampshire, was similar to the behavior of species indigenous to the arctic. The association of zooplankton behavior with morphological and physiological features and the variation in vertical distribution caused by environmental and physiological factors are discussed in terms of the selective forces on vertical migrations.
W81-00084

DIEBACK ROLE OF MYRIOPHYLLUM SPICATUM IN MONROE RESERVOIR, INDIANA,
Indiana Univ. at Bloomington. Dept. of Biology.
D. H. Landers, and D. G. Frey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-115685, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Research Center, Purdue University, West Lafayette, Indiana. Technical Report No 134, September 1980. 105 p, 23 Fig, 16 Tab, 70 Ref, 2 Append. OWRT-B-099-IND(1).

Descriptors: *Myriophyllum spicatum, *Ammonia, Nitrogen, *Dieback, Senescence, Cholorphyll, Phytoplankton, *Monroe Lake(IN), *Chemical reactions, *Lakes, *Limnology, *Seasonal, Nutrients, Phosphates, Nitrates.

Enclosures (2-m diameter) were placed in the littoral zone of Monroe Reservoir, Monroe Co., Indiana, to evaluate the chemical and biological effects of late summer dieback of Myriophyllum spicatum. Aerial photography, combined with quadrat sampling, was used to measure standing crop at peak summer biomass. Plant tissue analysis was applied to total biomass estimates to determine potential N and P release from senescing macrophytes. At the time of dieback, considerable pulses of Soluble Reactive Phosphorous (SRP), NH3-N and NO3-N were detected in the enclosures with plants and the adjacent open water sites. These nutrient inputs were associated with episodes of normal macrophyte senescence and decay. Chlorophyll a increased greatly in response to these nutrient inputs, indicating important increases in phytoplankton production as a direct consequence of macrophyte dieback. Crashing autumn phytoplankton populations were responsible for additional pulsed inputs of SRP, NH3-N and NO3-N in enclosed and open water locations. Realized nutrient inputs from senescent M. spicatum are estimated to represent as much as 20% of the annual P budget, and not more than 2.2% of the annual N budget for the reservoir.
W81-00085

AN ANNUAL BUDGET OF REDOX ACTIVE MATERIALS IN A LAKE,
Connecticut Univ., Storrs.
P. H. Rich.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-115644, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, August 15, 1980. 13 p, 3 Fig, 1 Tab, 2 Ref. OWRT-A-071-CONN(5).

Descriptors: *Oxidation-reduction potential, *Lakes, *Sediment-water interfaces, *Water quality, *Inorganic compounds, *Water chemistry, Lake sediments, Bottom sediments, Sediments, Mud-water interfaces, Ponds, Bodies of water, Sediment discharge, Peak discharge, Redox potential, Chemical reactions, Oxidation, Reduction(Chemical), Water properties, Carbon dioxide, Oxygen, Oxygen demand.

The objectives of this project covered (1) the determination of gross and net flux of iron, nitrogen, and sulfur compounds (redox-active) between interstitial water of surface sediments and the overlying lake water, through one annual cycle; (2) the determination of a synoptic material budget for the redox-active compounds in a small bog lake watershed; and (3) correlation of mineral activity in lake water and outflow stream with anaerobic benthic metabolism. It was noted that 50% more reducing power was generated as reduced alternate terminal electron acceptors in the lake (Durham Pond) as seen by reduction of oxygen to water; hence, areal hypolimnetic carbon dioxide increments better estimated total lake metabolism than areal hypolimnetic oxygen deficits. The watershed supplied more reducing power as dissolved organic matter than it supplied alternate electron acceptors on an annual basis. Finally, alternate electron acceptors were stored in oxidized form in surface sediments during circulation and high discharge periods, and used during both summer and winter stratification and low discharge. Hence, current input/output nutrient models accounted for a major biochemical energy transformation entraining redox-active elements and correlated within the lake ecosystem. (Zielinski-IPA)
W81-00092

CHANGES IN PHOSPHORUS CONCENTRATIONS DUE TO MIXING BY MOTORBOATS IN SHALLOW LAKES,
University of Central Florida, Orlando. Engineering and Industrial Experiment Station.
Y. A. Yousef, W. M. McLellon, and H. H. Zebuth.
Water Research, Vol 14, No 7, p 841-852, 1980. 9 Fig, 8 Tab, 22 Ref.

Descriptors: *Lakes, *Mixing, *Water quality, *Phosphorus, *Florida, Boats, On-site investigations, On-site tests, Turbidity, Data collections, Chlorophyll, Methodology, Nutrients, Water sampling, Dissolved oxygen, Propellers, Mechanical equipment, *Lake Claire(FL), *Lake Mizell(FL), *Lake Jessup(FL), Orthophosphorus, Organic carbon.

Recreational motorboats equipped with engines varying from 28 to 165 horsepower were operated at three selected Central Florida lakes. Also, a pair of isolation chambers representing aquatic habitats were placed in each lake for control and mixing studies. Mixing in isolation chambers was performed by small electrical motors connected to two blade propellers. Agitation of the water column in the lake mixing stations and inside the isolation chambers increased water turbidities and phosphorus concentrations. The increase in the orthophosphorus content for Lakes Claire, Mizell, and Jessup averaged 43, 16, and 73%, which corresponded to an average of 46, 24, and 105 mg-P of orthophosphorus resuspended per square meter of the bottom sediments, respectively. Similarly, the increase in the total phosphorus content for Lakes Claire, Mizell, and Jessup averaged 39, 28, and 55%, which corresponded to an average of 84, 58, and 249 mg-P/sq m, respectively. The increase in turbidity and phosphorus content occurred at a much higher rate than the rate of decline after cessation of mixing. The increase in phosphorus content could result in an increase in lake productivity as noticed from the increase of chlorophyll a concentrations in lake mixing stations. (Humphreys-ISWS)
W81-00100

PREDICTING FLUXES OF LATENT AND SENSIBLE HEAT OF LAKES FROM SURFACE WATER TEMPERATURES,
Florida Univ., Gainesville.
R. G. Bill, Jr., A. F. Cook, L. H. Allen, Jr., J. F. Bartholic, and T. Maki.
Journal of Geophysical Research, Vol 85, No C1, p 507-512, January 20, 1980. 5 Fig, 1 Tab, 14 Ref. OWRT A-031-FLA(3), 14-34-0001-8010.

Descriptors: *Heat flow, *Lakes, *Water temperature, On-site investigations, Measurement, Evaporation, Air temperature, Humidity, Winds, Instrumentation, Model studies, Mathematical models, Equations, Heat, Latent heat, Heat transfer, Correlation analysis, Meteorology, Limnology, Eddy correlation.

Wind velocity, air temperature, and humidity fluctuations were measured over Orange Lake, Florida, using an ultrasonic anemometer-thermometer and Lyman alpha humidity sensor. Latent and sensible heat fluxes were calculated from the data using the eddy correlation technique. Lake temperature at a 2.5-cm depth was measured in order to compare eddy correlation results with fluxes and the Bowen ratio predicted by the formulae of Hicks and Priestley and Taylor in which temperature is the sole parameter. Bowen ratio results were in good agreement with the formulations of Hicks and Priestley and Taylor if property values were evaluated at a temperature intermediate to the lake and 10-m air temperature. Disagreement with fluxes predicted by Hicks indicates that such formulations are inadequate for short-term flux evaluations under the meteorological conditions in which surface water temperature is changing with time. (See also W72-06439) (Sims-ISWS)
W81-00106

THE USE OF PERIODIC LIGHT APPLICATIONS OF ROTENONE AS A MANAGEMENT TECHNIQUE FOR SMALL IMPOUNDMENTS,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
G. S. Libey, and L. E. Holland.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-118770, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 132, September 1980, 39 p, 7 Fig, 7 Tab, 28 Ref. OWRT-A-054-IND(1).

Descriptors: *Fish management, *Rotenone, *Farm ponds, *Fish control agents, Pesticides, Bluegill, Bass, Balance of nature, Ecosystems.

A light (.1 ppm) application of rotenone was administered to two experimental ponds on June 26, 1979 in an effort to reduce larval bluegill survival through direct toxicity and by reduction of the food base (zooplankton) leading to starvation of the larvae. Zooplankton reductions caused by the toxicant could not be distinguished from natural fluctuations observed in the control pond. An average of .1 ppm concentration of rotenone caused noticeable increases in larval bluegill mortality without observed mortality or stress in bass or larger bluegill. A dosage of .07 ppm rotenone was observed to have minimal influence on larval bluegill numbers. An accurate, properly timed, light application of rotenone has potential as a useful and inexpensive (about $3) technique to

manage ponds with excessive prey (bluegill) production.
W81-00119

2J. Erosion and Sedimentation

CROSS-SECTION, VELOCITY, AND BED-LOAD DATA AT TWO EROSION SITES ON THE TANANA RIVER NEAR FAIRBANKS, ALASKA, 1979,
Geological Survey, Anchorage, AK. Water Resources Div.
R. L. Burrows.
Available from the OFSS, Box 25425, Fed. Ctr., Denver, CO 80225, $5.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-699, 1980. 32 p, 22 Fig, 4 Ref.

Descriptors: *Bed load, *Erosion, *Rivers, *Alaska, *Streamflow, Flow rates, Measurement, Sediment transport, Particle size, Sieve analysis, Hydraulics, Retaining walls, Hydrologic data, *Tanana River(AK), *Fairbanks area(AK).

In an effort to relate river processes to vertical and lateral erosion at two sites on the Tanana River in the vicinity of Fairbanks, Alaska, measurements of depth, velocity, and bedload-transport rates were made at several sections at each site. To facilitate comparison of the river processes and ongoing erosion, compilation and graphic presentation of the velocity distributions and bedload-transport rates are presented in conjunction with cross-section configuration immediately adjacent to the area of erosion. Dry sieve analyses of the bedload samples give particle-size distribution. Approximately 85 to 95% of the material in transport at both sites was in the sand range (>0.062 millimeter <2.0 millimeter). (USGS)
W81-00049

SEDIMENT-TRAP EFFICIENCY OF A MULTIPLE-PURPOSE IMPOUNDMENT, NORTH BRANCH ROCK CREEK BASIN, MONTGOMERY COUNTY, MARYLAND, 1968-76,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 4D.
W81-00060

2L. Estuaries

OCCURRENCE OF DAPHNIA PULEX IN LAKE ST. LUCIA,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Zoology.
S. J. M. Blaber, and N. Rayner.
South African Journal of Science, Vol 75, No 2, p 87, February 1979. 3 Ref.

Descriptors: *Daphnia, *Freshwater, *Estuarine environment, *Salinity, *Salt tolerance, Surface waters, Lakes, Plankton nets, Plankton, Daphnia pulex, South Africa, *Lake St. Luica(South Africa).

In August 1978, relatively large numbers of Daphnia pulex (Cladocera) were captured in South Lake St. Lucia, South Africa. They were captured during routine monthly plankton sampling in surface waters of 11% salinity, with no layering, and a temperature of 21 degrees C. Clarke-Bumpus nets were used. They were fitted with a flow-meter and 70 micrometer mesh net and a 'D' net (crossbar of 30 cm and an arch of 19 cm maximum height) also fitted with a 70 micrometer mesh net. None was captured in the 'D' net. D. Pulex is a freshwater group and their appearance in an estuarine system is significant. It is believed that they could have entered the system from the Mkuze River, 30 km to the north allowing a gradual acclimatization to saline water as a horizontal salinity gradient exists from north to south at St. Lucia. Because D. pulex has a freshwater distribution, little is known of its salinity tolerance. Its upper tolerance limit to magnesium chloride is 0.12 g/l, its tolerance of sodium being somewhat greater. (Stiles-IPA)
W81-00039

FRESHWATER RESOURCES OF BIG PINE KEY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
C. E. Hanson.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO. 80225, Paper copy $5.00, Microfiche $3.50. Geological Survey Open-File Report 80-447, 1980. 36 p, 15 Fig, 6 Tab, 5 Ref.

Descriptors: *Freshwater, *Groundwater resources, *Available water, Aquifer characteristics, Water quality, Saline water intrusion, Tidal effects, Water level fluctuations, Rainfall, Pumping, Water wells, Water analysis, Potable water, Potential water supply, Planning, Hydrographs, Data collections, Freshwater lens, *Big Pine Key(FL), Saline water-freshwater interfaces.

The principal freshwater-bearing unit underlying Big Pine Key, Fla, is a layer of oolitic limestone averaging 19 feet in thickness. The freshwater exists in two separate lenses, one in the northern half of the island and one in the southern half. The slightly larger north lens is separated from the south lens by a low-lying land area 1 to 3 feet above mean sea level. The lenses float on saltwater in the aquifer and are affected by tidal fluctuations. The areal and depth configuration of the lenses fluctuate in response to rainfall, evapotranspiration, lateral and vertical losses, and pumpage from local wells. The lenses are not a major source of freshwater. Only a small amount of the freshwater in the lenses can be removed before saltwater intrusion will occur. (USGS)
W81-00069

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

RESEARCH AND DEVELOPMENT ON A SPIRAL-WOUND MEMBRANE SYSTEM FOR SINGLE-STAGE SEAWATER DESALINATION,
UOP Inc., San Diego, CA. Fluid Systems Div.
R. L. Riley, and C. E. Milstead.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-105918, Price codes: A10 in paper copy, A01 in microfiche. Final Report to Office of Water Research and Technology, August 1977, 207 p, 52 Fig, 63 Tab, 14 Ref. OWRT (No 6516) (1), 14-34-0001-6516.

Descriptors: *Membranes, *Reverse Osmosis, *Desalination, *Sea water, *Spiral-Wound Elements, Separation techniques, Desalination processes, Desalination apparatus, Research and development.

Spiral-wound thin-film composite membrane systems have been developed for seawater desalination by reverse osmosis. Among the most promising membranes developed are a family of aromatic poly (ether/amides) and poly)ether/ureas). These membranes exhibit outstanding transport, mechanical, thermal, biological, and chemical properties. The major effort during the program focused on the poly (ether/amide) thin-film composite membrane, designated PA-300. Membrane fabrication optimization studies resulted in the scale up of the process from 14-in. to 38-in. wide membrane produced on a continuous basis. Characterization studies under various operating conditions were conducted. For single-pass seawater desalination, stable water fluxes of 9.0 gal/ft super 2-day and sodium chloride rejections of greater than 99% were attained with two- and four-in. diam. PA-300 membrane elements at an applied pressure of 650 psi in pilot plant tests at Sea World Marine Park in San Diego, CA. Water fluxes of 10-13 gal/ft super 2-day and rejections of 98-99% were attained with 30-45% water recovery at an applied pressure of 800 psi with four- and six-in. diam. PA-300 membrane elements in two-stage seawater desalination pilot tests at Wrightsville Beach, NC. The establishment of large-scale continuous membrane production, combined with excellent seawater performance of spiral-wound elements demonstrates a significant advance toward the commerical application of thin-film composite membranes.
W81-00001

DEVELOPMENT OF A CHLORINE-RESISTANT COMPOSITE MEMBRANE FOR REVERSE OSMOSIS,
Envirogenics Systems Co., El Monte, CA.
A. F. Graefe, and D. Wong.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-115420, Price codes: A03 in paper copy, A01 in microfiche. Final Report No 2001-20 to Office of Water Research and Technology, August 1980, 40 p, 4 Ref. OWRT-C-80 298-5 (No 8529)(1), 14-34-0001-8529.

Descriptors: *Reverse osmosis, *Membrane, Composite, *Seawater, Brackish water, *Desalination, Polysulfone, Sulfonated polysulfone, Lactic acid, Non-Cellulosic.

The objective of this program was to develop chlorine-resistant non-cellulosic composite desalination membranes that would exhibit a minimum flux of 10 gfd at greater than 99% salt rejection when tested with synthetic seawater at 1000 psi, and/or a minimum flux of 15 gfd at greater than 90% salt rejection when tested with 5000 ppm sodium chloride at 250 psi. The membrane selected for this purpose consisted of a sulfonated polysulfone barrier layer overlaid on the surface of unmodified microporous polysulfone as a support. In work involving sulfonated polysulfone dense films, a study was conducted in which various cloth-backed polysulfone supports were pretreated with aqueous lactic acid, followed by brushing with 0.5% sulfonated polysulfone in 2-methoxyethanol. The purpose of the lactic acid was to prevent intrusion of sulfonated polysulfone into the support pores. The best membrane specimen exhibited a water flux of 32.3 gfd at 94.5% salt rejection when tested with 0.5% sodium chloride at 250 psi. These data exceeded the program performance goal set for brackish water. Another membrane showed 11.3 gfd at 90.1% salt rejection when tested under the same conditions. However, several attempts to reproduce these results were unsuccessful. Several sulfonated polysulfone composite membranes containing asymmetric barrier layers were fabricated by brush-coating microporous polysulfone supports with sulfonated polysulfone in 2-methoxyethanol, followed by gelation in water at 1C. Salt rejection values for these membranes, when tested under brackish water conditions, was limited to about 90%.
W81-00002

DESIGN STUDY OF THE VTE BOILER CYCLE FOR THE DESALINATION OF SEA WATER VOLUME 1. MAIN REPORT AND APPENDIX A,
Envirogenics Systems Co., El Monte, CA.
I. Kamal.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-113151, Price codes: A10 in paper copy, A01 in microfiche. Final Report to Office of Water Research and Technology, January 1980. 180 p. OWRT-C-80277-S(No 8565)(1), 14-34-0001-8565.

Descriptors: *Desalination, *Sea water, *Desalination apparatus, *Design, *Cost comparisons, Efficiencies, Evaluation, Boilers, Heat transfer, Computer programs, *VTE boiler.

Flow sheets have been developed for the VTE boiler cycle, which is a dual-purpose power/desalination system. Computer programs have been written and used to calculate equivalent performance ratios and process data for the VTE boiler and the conventional dual-purpose plant with both extraction and back-pressure schemes of steam supply to the evaporator. High EPRs are obtained for the VTE boiler when (a) the heating steam is withdrawn from the turbine at a low pressure, (b) the secondary turbine is designed for high efficiency, (c) the number of effects in the VTE boiler is small and (d) the temperature driving potential is small. The thermal loss to the power cycle is low, with the VTE boiler acting like a moisture separator returning dry, steam to the turbine cycle at condi-

tions close to those under which the steam was withdrawn. Cost studies have been carried out for the VTE boiler and the conventional system for 50 MWe/1 mgd. The studies show that the energy requirement of the VTE boiler is less than half that of the conventional plant when both are designed for optimum performance. Further work on the development of economical and efficient low-pressure turbines is necessary in order to realize the potential of the VTE boiler.
W81-00071

A PROCESS DESIGN OF A 60,000 GALLON PER DAY VACUUM FREEZING EJECTOR ABSORPTION PILOT PLANT,
Chicago Bridge and Iron Co., IL.
V. F. Allo, G. E. Engdahl, J. A. Nail, T. J. Nowak, and D. C. Stafford.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-114688, Price codes: A07 in paper copy, A01 in microfiche. Final Report to U. S. Department of the Interior, Office of Water Research and Technology, July, 1980. 118 p, 2 Append. OWRT-C-90058-D(No 9512)(2), 14-34-0001-9512.

Descriptors: *Desalination plants, *Design specifications, *Pilot plants, *Desalination processes, Design, Freezing, Engineering, Construction, Hydrologic aspects, Design data, Design standards, Heat balance, Design criteria, Crystallization, Water purification, Facilities.

A conceptual design study was completed of the vacuum freezing ejector absorption (VFEA) process, a freeze desalination process in which water vapor from a vacuum freezer is compressed by combined action of a streamjet ejector and an absorption refrigerator. The development program was intended to prove technical and economic feasibility of this process. The report includes design specifications for a 60,000 gallons per day pilot plant, complete with detailed equipment specifications and engineering drawings. Construction of a VFEA pilot plant and advancement of the VFEA process through the pilot and demonstration phases was recommended on the basis of indicated lower water costs for the VFEA process. The VFEA process retains the intrinsic advantages of freezing processes of having no pretreatment, negligible scaling and fouling, and minimal corrosion. However, the VFEA process utilizes low grade thermal energy more efficiently than any existing desalination process. The projected power costs for the VFEA process were forecasted to be less than those attainable in the foreseeable future by any distillation or membrane plant in seawater desalting service. A VFEA computer program model was designed for steady state plant mass and heat balance to simulate effects of saline feed factors on plant performance. (Zielinski-IPA)
W81-00077

RESEARCH ON OXYGEN IN THE FEED WATER TO A REVERSE OSMOSIS PILOT PLANT AT THE WRIGHTSVILLE BEACH TEST FACILITY,
Office of Water Research and Technology, Washington, DC.
R. S. Robinson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-113219, Price codes: A06 in paper copy, A01 in microfiche. Final Report (1980), 84 p, 4 Fig.

Descriptors: *Desalination, *Reverse osmosis, *Feedwater pretreatment, Flux enhancement, *Pilot plants, Desalination processes, *Oxygen, Sea water, Temperature, Wrightsville Beach(NC).

An evaluation was made on the influence of dissolved and undissolved oxygen (O2) in the feed water to a spiral wound seawater reverse osmosis (R.O.) pilot plant. A series of tests were conducted with O2 either added to or deaerated from the seawater. Use of additives to improve salt rejection also was evaluated. Changes in ambient temperature flux and salt rejection performance of the R.O. elements were determined as a function of O2 addition or deletion from feedwater.
W81-00080

WATER STORAGE CONTROL FOR REVERSE OSMOSIS SYSTEM,
Desalination Systems, Inc., Escondido, CA. (Assignee).
R. A. Tondreau, and D. T. Bray.
U.S. Patent No 4,190,537, 6 p, 4 Fig, 4 Ref. Official Gazette of the United States Patent Office, Vol 991, No 4, p 1370-1371, February 26, 1980.

Descriptors: *Patents, *Desalination, *Water treatment, Reverse osmosis, Membrane processes, Separation techniques, Semipermeable membranes, Desalination apparatus.

A reverse osmosis system employs a tank for storing permeate under a pressure which is a portion of the pressure of feed water introduced into a pressure resistant container housing a semipermeable membrane cartridge. Control means such as an automatic valve, preferably of the double diaphragm type, in the line introducing feed water closes to shut off feed water flow when the pressure in the permeate storage tank reaches a first predetermined value, less than the feed water pressure, and re-opens to re-establish feed water flow at a second predetermined pressure lower than the first or shut-off pressure. A constricted passageway device such as a venturi in the pipe or connection between a dispensing device such as a faucet and the permeate storage tank has its throat communicating with the sensing conduit for actuating the feed water control valve. When the dispensing faucet is opened, flow of permeate through the venturi creates an amplified and drastically reduced pressure in the sensing conduit, and applies a servo or magnified actuation force to the valve in the re-open end of its control range. (Sinha-OEIS)
W81-00133

EVALUATION OF TECHNICAL MATERIAL AND INFORMATION FOR SEAWATER DESALTING DEMONSTRATION PLANTS.
Boyle Engineering Corp., San Diego, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-118804, Price codes: A08 in paper copy, A01 in microfiche. Completion Report prepared for Office of Water Research and Technology, August, 1980. 81 p, 38 Ref, 6 Append. OWRT-C-00183-D(No 0453)(1).

Descriptors: *Desalination plants, *Reverse osmosis, *Sea water, *Water shortage, *Evaluation, *Water purification, *Sites, Saline water, Oceans, Salinity, Saline water conversion, Desalination processes, Water supply, Salt extraction, Water desalting, Appraisals, Demineralization, Separation techniques, Osmosis, Potable water, Islands.

Evaluation was conducted of technical information/material provided by applicants to the OWRT Desalting Demonstration Plant Program, authorized by P.L. 95-84 and 95-467 to demonstrate state-of-the-art in desalting technology. The evaluation used eight criteria: interest and commitment; and considerations for general site, desalting needs, demographics and socio-economics, water supply, financial, energy, and environmental. Twenty sites located in thirteen states, the Mariana Islands, and the Virgin Islands were evaluated under these criteria. The sites were ranked by raw cumulative score. Sites with critical water needs were identified in both small and large cities. Comments were provided on the top ten ranked sites. The top ranked site to demonstrate single-stage reverse osmosis (RO) desalination was Grand Isle, Louisiana. The second ranked site was Key West, Florida, partly since its water shortage has become more acute than two years ago. It was determined that all twenty site applications were justified for consideration in the seawater RO demonstration plant program and that more than half would have been excellent demonstration plant sites, but critical water shortage of the two top ranked sites and other qualifications mandated their high rankings. (Zielinski-IPA)
W81-00199

DEVELOPMENT OF COMPOSITE HOLLOW FIBERS,
Bend Research, Inc., OR.
R. W. Baker, R. P. Barss, and H. K. Lonsdale.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-119554, Price codes: A03 in paper copy, A01 in microfiche. Final Report of Phase I, March 1980, 40 p, 19 Fig, 7 Tab, 10 Ref. OWRT-S-0017(No 7552)(1), 14-34-0001-7552.

Descriptors: *Reverse osmosis, *Desalination, Hollow fibers, Fiber spinning, Composite membrane.

The objective of this program is to demonstrate the feasibility of using inside-skinned composite hollow fibers for brackish water desalination via reverse osmosis. Composite hollow fibers potted in modules with tube-side feed should be more resistant to fouling and less expensive than current module designs, partly because expensive pretreatment of the feed is unnecessary and partly because the fibers are self-supporting and do not require expensive pressure-containment vessels. The performance of these fibers compares favorably with current cellulose acetate brackish water membranes, and is superior to commercial brackish water hollow fiber systems. (Rykken-Bend)
W81-00200

MULTI-STAGE FLASH DISTILLATION PROCESSES,
Technische Hogeschool, Delft (Netherlands).
A. W. Veenman.
Effluent and Water Treatment Journal, Vol 20, No 8, p 371-375, 377, August, 1980. 9 Fig, 1 Tab, 11 Ref.

Descriptors: *Desalination, *Flash distillation, Heat exchangers, *Operating costs, *Pilot plants, Desalination apparatus, Desalination processes, Distillation, Long-tube vertical distillation, Scaling, Evaporators, Condensers, Multi-stage flash distillation.

A new system for desalination of ocean water is described. It is based on multi-stage flash distillation technology which is presently the dominant conventional method. In the new system, costs of energy consumption are reduced. Less specific heat is required for evaporation, the fouling factor of the heat exchanger is reduced, and the product output per volume is increased. The new system combines a vertical evaporator with a fluidized bed heat exchanger in one integrated column. Evaporation takes place in a vertical series of chambers each at a reduced saturation pressure. Condensation occurs simultaneously with the transfer of heat to feedwater in the heat exchanger. This is achieved in parallel condenser tubes partially filled with solid particles in a fluidized state. The system has been in operation for three years in pilot plants in the Netherlands. (Titus-FRC)
W81-00228

3B. Water Yield Improvement

EXPANSION VERSUS CONSERVATION OF WATER SUPPLY,
Library of Congress, Washington, DC.
W. Viessman.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 117-121, 1979. 4 Ref.

Descriptors: *Water supply development, *Water conservation, *Water resources development, *Water supply, Planning, Drought, Water shortage, Forecasting, Water policy, Water costs, Environmental effects, Alternate planning, Economic feasibility, Water resources.

Despite the current emphasis on water conservation practices, there is a need for new water supply development. Conservation will not solve all of our water problems. Even with maximum conservation the water saved would soon be assimilated in new growth especially in water-short rapid growth areas such as the Southwest. Also, there are risks associated with the conservation approach to water management. In the past many areas survived droughts because there was room to con-

serve, but with maximum conservation already in place during normal times there is no margin of safety for times of drought. Uncertainty about the effectiveness of many water conservation measures also puts more emphasis on continued water supply development. The economics of conservation should also be considered. The encouragement of conservation practices beyond economically and environmentally feasible limits is questionable. Many social and institutional barriers to conservation still exist. It is often difficult to get people to accept and use the available technology. Conservation shoul be used as an option, where effective, in water supply planning but it does not eliminate the need for additional water supply development. (See also W81-00160) (Seigler-IPA)
W81-00173

HIGH PLAINS DROUGHT: LESSONS AND PLANNING,
Texas Dept. of Water Resources, Austin.
H. W. Grubb, M. L. Wright, G. W. Bomar, and C. A. Tuck.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 218-227, 1979. 3 Tab, 6 Ref.

Descriptors: *Great Plains, *High Plains, *Droughts, Irrigation water, Planning, Forecasting, Legislation, Rain-enhancement, Water reuse, Water policy, Agriculture, Semiarid climates, Water supply, Groundwater, Water shortage.

The Great Plains Region, an area of important food grains, fiber, feed grains, and beef production, is subject to periodic extended droughts which have a major economic effect on the local, regional, and national economies. The area has extensively developed irrigation using exhaustible groundwater reserves to produce from 2.5 to 4.0 times the crop yields expected from dryland acres. This irrigation also stabilizes annual income and produces a larger supply of food and fiber materials for national and export markets. Repeated droughts in the area clearly illustrate the need for more reliable long-range weather forecasting techniques and expanded development of supplemental water supplies. More accurate forecasting is difficult due to the extreme variability in time and space of drought on the Great Plains. While conservation is frequently proposed as an alternative to development, increasing the water supply will reduce economic effects. Two potential major water supply management techniques for the area are reuse and rain-enhancement. Legislative actions have been taken to study ways of planning for supplemental water supplies. A study is now underway to: (1) protect the Nation's continued food supply, (2) promote the economic vitality of the region, and (3) evaluate alternative development strategies. (See also W81-00160) (Seigler-IPA)
W81-00187

3C. Use Of Water Of Impaired Quality

AN ECONOMIC EVALUATION OF GREENBELT IRRIGATION WITH EFFULENT WATER,
California Univ., Riverside. Dept. of Botany and Plant Sciences.
W. W. Wood, V. B. Younger, G. B. Benoit, and D. R. Hurd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-112666, Price codes: A04 in paper copy. California Water Resources Center, University of California, Davis Technical Completion Report, September 1980, 72 p, 8 Tab, 2 Append. (California Water Resources Center Project UCAL-WRC-W-532). OWRT-A-065-CAL (1).

Descriptors: *Wastewater disposal, *Effluents, *Irrigation, *Economics, *Energy, Costs, Reclaimed water, Water reuse, California, Maloney Canyon Project(CA).

Land disposal of wastewater, although not a new concept, has received widespread interest in recent years because of an increased need to conserve water and a greater public concern about water pollution. While there have been numberous recent research projects on the use of wastewater for irrigation, very few have dealt specifically with the economic aspects. The maloney Canyon Project in California has shwon that greenbelt irrigation with wastewater is feasible from the biological and physical standpoints. Based on the above project, this research attempted to quantify the specific monetary and energy costs associated with land application renovation of wastewater, and to a lesser extent consider the long-run implications. In the first half of this study the attempt was made to see whether land application compares favorably with other forms of advanced wastewater treatment. Relationships between the fundamental characteristics of plant types such as capacity, treatment unit type, capital cost, etc., were studied by using statistical analysis such as linear regression, crosstabulations, and factor analysis. The last objective of this paper was to estimate the fixed, variable, and total cost functions of applying water through greenbelt irrigation as those functions vary relative to capacity, design, and geography. (Snyder-CA).
W81-00025

EFFECTS OF SPRAY IRRIGATION OF MUNICIPAL WASTEWATER ON TRACE METALS IN SEVERAL CROP AND FOREST ECOSYSTEMS,
Pennsylvania State Univ., University Park. School of Forest Resources.
W. E. Sopper, and S. N. Kerr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-114001, Price codes: A04 in paper copy, A01 in microfiche. Institute for Research on Land and Water Resources, The Pennsylvania State University, Research Project Technical Completion Report, Sept. 1980, 30 p, 15 Tab, 7 Ref. OWRT-B-083-PA (2), 14-31-0001-5109.

Descriptors: *Irrigation effects, *Municipal wastes, *Impaired water use, *Crop response, *Forestry, Water reuse, Water quality, Waste water, Soil analysis, Treated municipal waste water, Trace metals, Forest ecosystem, Tree growth, Soil samples, Vegetation samples, Foliar samples, Waste water quality, Agronomic crops.

Since 1963 secondary treated municipal wastewater has been spray-irrigated on crops and forestland at various application rates at The Pennsylvania State University. In general, results have indicated that the wastewater applications have been beneficial in terms of increasing crop yield and tree growth and that the wastewater can be satisfactorily renovated for groundwater recharge. In 1975, soil and vegetation samples were collected from all control and irrigated plots for trace metal analysis. The highest applications of wastewater was at a rate of 5 cm per week. At this rate approximately 18.8 m of wastewater were applied during the period 1963 to 1975. Soil samples were collected at the 0-5, 5-10, 10-15 and 15-30 cm depths. Foliar samples were collected from the agronomic crops and from the trees and subordinate vegetation in the forest stands in both the irrigated and control areas. Soil and vegetation samples were analyzed for copper, zinc, chromium, lead, cobalt, cadmium, and nickel. It can be concluded from the data collected that wastewater irrigation at The Pennsylvania State University Farms did not significantly increase the trace metal concentrations in the soil or vegetation after 13 years of application.
W81-00041

MUNICIPAL SEWAGE EFFLUENT APPLICATION TO SOILS BEARING HARDWOOD COPPICE AND LOBLOLLY PINE STANDS,
Clemson Univ., SC. Dept. of Forestry.
C. L. Lane, N. R. Page, B. R. Smith, A. T. Shearin, and R. O. Hegg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-113987, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute, Clemson University Report No 85, 1980, 17 p, 2 Fig, 5 Tab, 100 Ref. OWRT-B-096-SC (1).

Descriptors: *Sewage effluents, *Forest soils, Piedmont soils, Wastewater, Loblolly pine trees, Hardwood, Coppice, Tree growth, *Irrigation effects, *Water reuse, *Effluent renovation, Forestry, Spray irrigation.

Treated municipal sewage effluent was spray irrigated on an area adjacent to the sewage treatment plant of the Town of Clemson, SC. A hardwood coppice and a 35-year-old loblolly pine plantation were irrigated with weekly treatments for two years. These treatments were zero, 2.5 cm, 5 cm and a variable rate that during the growing season was 11.5 cm equivalent irrigation per week. Two-year biomass production on the coppice stand was proportional to treatment rates being 5030 kg/ha, 6500 kg/ha, 7700 kg/ha, and 9700 kg/ha dry weight, respectively. Height growth of the pines was 183 cm, 189 cm, 219 cm, and 261 cm. Diameter growth of the pines was one cm for all treatments. Soil analysis for fecal coliforms showed that by the time the effluent reached 45 cm, they had been effectively removed. There was no evidence of any groundwater or adjacent stream contamination at the rates applied.
W81-00043

THE PRODUCTION OF AGRICULTURALLY USEFUL MUTANT PLANTS WITH CHARACTERISTICS CONDUCIVE TO SALT TOLERANCE AND EFFICIENT WATER UTILIZATION,
Colorado State Univ., Fort Collins. Dept. of Botany and Plant Pathology.
M. W. Nabors.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-114712, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, October 1979. 35 p, 2 Fig, 1 Tab, 22 Ref, 5 Append. Colorado Water Resources Research Institute, Colorado State University. OWRT-C-7017 (no 6232)(1), 14-34-0001-6232.

Descriptors: *Salt tolerance, *Saline soils, *Plant growth, *Greenhouses, Growth chambers, Salinity tolerance, Resistance, Salts, Sodium compounds, *Agriculture, Wheat, Corn(Field), Oats, Tobacco, Tomatoes, Vegetable crops, Cultures, Colorado.

The current estimate of $16 million for annual damage from excess salinity in the Colorado basins is expected to reach $51 million by the year 2010. Feasibility for utilizing new varieties of plants designed for compatibility with excess salinity was investigated. The report demonstrates that available tissue culture methodology can be used to rapidly select NaCl-tolerant cell lines and to regenerate whole plants from these lines. The regenerated plants were shown to be salt-tolerant in greenhouse experiments, and were found capable of passing this tolerance onto two generations of offspring. It thus appears that salt tolerance, which can be economically selected in tissue culture, is both persistent and inheritable in regenerated plants. Salt-tolerant cell lines were selected in wheat, oats, and tobacco, and salt-tolerant plants were regenerated from these three cell line species. Greenhouse testing was nearly complete for tobacco, and was underway for oats. The goal of increasing arid land food production may be best achieved by producing compatible plant varieties. In addition, considerable advancement in tissue culture methodology was achieved for sugarbeets, tomatoes, and corn, and mutation selection could begin now in tomatoes and within a year in corn and sugarbeets. (Zielinski-IPA)
W81-00076

THE UTILIZATION OF TREATED MUNICIPAL WASTEWATER FOR CROP PRODUCTION IN BUCKEYE, ARIZONA,
Arizona Univ., Tucson. Dept. of Plant Sciences.
J. A. McFadyen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-115214, Price codes: A04 in paper copy, A01 in microfiche. M.S. Thesis, 1976. 44 p, 15 Tab, 35 Ref. OWRT A-050-ARIZ(3), 14-31-0001-5003.

Descriptors: *Irrigation effects, Irrigation practices, *Wastewater reuse, Municipal wastes, Water conservation, *Crop response, Water reuse, *Crop production, Arizona, Wheat, Barley, Alfalfa, Soil properties, Pump water-waste water mixture.

Production of selected crops irrigated with treated municipal wastewater and pump water mixtures and with pump water alone was investigated. Wheat and barley irrigated with wastewater-pump water mixtures produced higher grain yields than did wheat and barley irrigated only with pump water. Alfalfa hay yields were higher for fields irrigated with wastewater-pump water mixtures than for fields irrigated with pump water alone. No differences were noted between irrigation treatments for safflower seed yields or for lint cotton yields. The pump water alone irrigated fields were fertilized by grower applications and by nutrients in the irrigation water with more nitrogen but less phosphorus than the wastewater-pump water mixture irrigated fields. Soils irrigated with wastewater-pump water mixtures had higher levels of extractable phosphorus than did soils irrigated with pump water alone. Pump water had higher concentrations of soluble salts and nitrate-nitrogen than did the wastewater-pump water mixtures; however, the wastewater-pump water mixtures contained higher levels of phosphorus than did pump water. Treated municipal wastewater can be utilized effectively as a source of plant nutrients and irrigation water in the commercial production of field crops in the southwestern United States.
W81-00086

WASTEWATER HELPS THE BARLEY GROW,
Arizona Univ., Tucson. Dept. of Plant Sciences.
A. D. Day, J. A. McFadyen, T. C. Tucker, and C. B. Cluff.
Water & Wastes Engineering, August 1979, p 26-28. OWRT-A-050-ARIZ(2), 14-31-0001-5003.

Descriptors: *Irrigation effects, *Waste water, *Barley, Growth rates, Experimental farms, Grains(Crops), Arizona, Pump water-wastewater mixture, Soil properties.

Experiments were conducted in southern Arizona to investigate the effects of irrigation with pump water and a pump water-wastewater mixture on barley (Hordium vulgare L.) growth, grain yield, and grain quality; soil properties; and irrigation water quality. In 1974 and 1975, on small plot research, barley irrigated with a 50:50 mixture of pump water and wastewater significantly exceeded barley irrigated with pump water alone in plant height, number of heads per unit area, number of seeds per head, seed weight, grain yield, and straw yield. In large field studies conducted from 1970 through 1977, barley irrigated with the mixture had taller plants, more lodging, lower grain volume-weights and higher grain yields than barley irrigated with pump water alone. Soils irrigated with both types of irrigation water had similar pH. Soluble salts (ECx10(3)), exchangeable sodium percentage, nitrate-nitrogen, and extractable phosphorus were significantly higher in soils irrigated with the pump water-wastewater mixture than in soils irrigated with pump water. Water quality analyses showed that the pump water-wastewater mixture had lower total soluble salts, lower nitrate-nitrogen, and higher phosphorus levels than pump water alone.
W81-00097

COMMERCIAL PRODUCTION OF WHEAT GRAIN IRRIGATED WITH MUNICIPAL WASTE WATER AND PUMP WATER,
Arizona Univ., Tucson. Dept. of Plant Sciences.
A. D. Day, J. A. McFadyen, T. C. Tucker, and C. B. Cluff.
Journal of Environmental Quality, Vol 8, No 3, p 403-406, July-Sept. 1979. OWRT-A-050-ARIZ(1), 14-31-0001-5003.

Descriptors: *Irrigation effects, *Municipal wastes, *Waste water, *Wheat, Growth rates, Experimental farms, Grains(Crops), Arizona, Soil properties, Pump water-wastewater mixture.

Experiments were conducted in southern Arizona to study the effects of irrigating wheat (Triticum aestivum L.) with a mixture of pump water and waste water and with pump water alone on wheat growth, grain yield, grain quality, soil properties, and irrigation water quality. In small plot research, wheat irrigated with the pump water-waste water mixture produced taller plants, more heads per unit area, heavier seeds, higher grain yields and higher straw yields than did wheat grown with only pump water. When large fields were compared, wheat grown with the pump wastewater mixture had taller plants, more lodging, lower grain volume-weights, and higher grain yields than did wheat produced with pump water. The pH and exchangeable sodium of soil irrigated with pump water alone or the pump water-waste water mixture were similar. Soluble salts and nitrate-nitrogen were higher in soils irrigated with pump water than they were in soils irrigated with the pump water-waste water mixture. Extractable phosphorus was higher in soils irrigated with the pump water-waste water mixture than in soils irrigated with pump water. Total soluble salts and nitrate-nitrogen were higher in pump water than they were in the pump water-waste water mixture; however, the pump water-waste water mixture had higher levels of total nitrogen and phosphorus than did pump water. The higher grain yields obtained when wheat was irrigated with the pump water-waste water mixture than were produced when wheat was grown with pump water alone probably resulted from lower concentrations of soluble salts in the pump water-waste water mixture than were present in pump water.
W81-00098

HYDROGEOLOGIC DATA FOR THE MCKAY CREEK SUBSURFACE WASTE-INJECTION TEST SITE, PINELLAS COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. J. Hickey.
Geological Survey Open-File Report 77-802, November 1977. 94 p, 17 Fig, 32 Tab, 18 Ref.

Descriptors: *Hydrologic data, *Injection wells, *Waste disposal wells, *Baseline studies, Water quality, Hydrologic properties, Underground storage, Effluents, Path of pollutants, Test wells, Water levels, Water analysis, Hydrogeology, Florida, Pinellas County(FL).

Lithologic, hydraulic, geophysical, and water-quality data collected at the McKay Creek subsurface waste-injection test site in Pinellas County, Florida, are reported. Data were collected to determine the possibility of subsurface injection of waste-treatment plant effluent. One exploratory hole, one test injection well, and eight observation wells were constructed between May 1973 and February 1976. The exploratory hole was drilled to a depth of 1,750 feet below land surface; the test injection well is open in dolomite between 952 and 1,040 feet; and the observation wells are open to intervals above, in, and below the test injection zone. The lithology of the upper 100 feet is predominantly clay. From 100 to 1,750 feet below land surface, limestone and dolomite predominate. Gypsum is present 1,210 feet below land surface. Laboratory analyses of cores taken during drilling are given for vertical intrinsic permeability, porosity, interval transit time, and compressibility. Specific capacities tested during drilling range from 4 to 2,500 gallons per minute per foot of drawdown. An 83-hour withdrawal test at 4,180 gallons per minute and a 2-month injection test at 650 gallons per minute were run. Small water-quality changes were observed in one observation well immediately above the test injection zone during and after the injection test. Formation water in all of the wells with the exception of the shallowest observation wells is saline. The vertical position of saltwater is estimated to be at about 280 feet below land surface. Thirteen wells within a 1-mile radius of the test site were located and sampled for water quality. (USGS)
W81-00152

3D. Conservation In Domestic and Municipal Use

PROCEEDINGS OF THE CONFERENCE ON WATER CONSERVATION NEEDS AND IMPLEMENTING STRATEGIES,
Conference held July 9-13, 1979, at Franklin Pierce College, Rindge, NH, American Society of Civil Engineers, New York, NY, 1979. 276p

Descriptors: *Droughts, *Planning, Water shortage, Water policy, Risks, Water demand, Water supply, Mathematical models, Streamflow forecasting, Reservoirs, California, Water rates, Legislation, Water management(Applied), Hydrology, Urbanization.

Twenty-nine papers discussing the evidence available to recommend water conservation and to identify the studies still needed were presented by scientists and engineers at the conference. Three major facets of water conservation discussed were: (1) the role and degree of effectiveness of legislative, administrative, legal, and political science forces; (2) the technical, engineering, and scientific methods available; and (3) the financial and economic means available to influence water conservation. The conferene concluded that President Carter's basic policy on water conservation is theoretically sound, however, several of its components need clarification. Legislative and executive action should be designed to assure that conservation is one of several alternatives considered and it should not discourage structural approaches when they are the most efficient alternative. No nationally applicable statement can be made about the technical effectiveness and impact of water conservation measures. Individual site-specific studies will be needed to draw effectiveness conclusions. Also, conservation measures, while saving water, may not be cost effective depending on the specific situation. Allocation of the costs of water conservation among beneficiaries will be necessary as conservation for conservation's sake could have serious economic consequences. (See W81-00161 thru W81-00189). (Seigler-IPA)
W81-00160

WATER CONSERVATION: THE FEDERAL VIEWPOINT,
Water Resources Council, Washington, DC.
L. M. Eisel.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979. Franklin Pierce College, Rindge, NH, p 22-27, 1979.

Descriptors: *Water conservation, *Water policy, *Federal government, *Planning, Legislation, Water resources development, Water supply, Environmental effects, Federal-State water rights conflicts, Water rights, Grants, Government finance, Water costs, Water demand, Programs.

Water conservation is the cornerstone of President Carter's National Water Policy, however, the national role in water conservation will be cooperation, not preemption of local and State authority. The National Water Policy also calls for improved planning and management of Federal water resources programs and increased attention to environmental quality. To implement the objectives of the policy, 13 directives were issued to various responsible Federal agencies. Specific tasks were assigned and each agency is required to seek input from State, county, local, and non-governmental agencies in the development of implementation plans. Nineteen task forces are at work implementing the directives in areas such as floodplain management, Soil Conservation Service programs, Federal water pricing, technical assistance, loan and grant programs, agricultural assistance, nonstructural flood protection, and Federal and Indian reserved water rights. Up-to-date summaries of agency actions can be found in the 'Final Summary Report' of Water Conservation Task Force 6A. Funding to assist states with water conservation will be available when the Water Conservation Technical Assistance Grants Program is authorized. It will provide matching funds for education

and information dissemination, technical assistance, and water exchanges. It is the national viewpoint that there is no national water crisis -- and, with emphasis on conservation, there will not be a crisis. (See also W81-00160) (Seigler-IPA)
W81-00161

URBAN WATER BALANCES CONSIDERING CONSERVATION,
American Society of Civil Engineers, Marblehead, MA. Urban Water Resources Research Program.
M. B. McPherson.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979. Franklin Pierce College, Rindge, NH, p 28-36, 1979. 2 Fig, 22 Ref.

Descriptors: *Water conservation, *Urban hydrology, *Water sources, Urbanization, City planning, Potable water, Input-output analysis, Industrial water, Domestic water, Water supply, Water allocation(Policy), Water loss, Water users, Water utilization.

A graphical representation of water quantities in a hypothetical urban area of one-million inhabitants is used along with a composite public water/waste water input - output balance to illustrate the major factors in water conservation for urban areas. Although such water balance inventories describing the quantity and quality aspects of water are advocated as a referencing tool for planning in metropolitan areas, very few have been developed. In accounting for water quantities two major factors are: (1) the bulk of supplied water originates outside of urban area; and (2) over half of all water is in private hands. Public water supply withdrawals are a relatively small fraction of total metropolitan withdrawals, and domestic use represents a modest fraction of these public water withdrawals. Due to these proportions and ambiguities in the amount of 'unaccounted-for' water in a system, any savings in domestic use through conservation would be difficult to prove. 'Dual' community water distribution systems represent an area of likely conservation since only a small fraction of public water supplies needs to be of 'drinking water' quality. Other major areas for conservation are the reduction of leakage and the reduction of peak rate usage. A long-term important national water development is the greater appreciation of the complex interconnections, interactions, and interrelations among the numerous facets of water in the urban environment. (See also W81-00160) (Seigler-IPA)
W81-00162

LOCAL DROUGHT-INDUCED CONSERVATION CALIFORNIA EXPERIENCES,
California State Dept. of Water Resources, Sacramento.
G. H. Meral.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 37-46, 1979. 1 Fig, 3 Tab.

Descriptors: *California, *Water conservation, *Drought tolerance, Water utilization, Agriculture, Irrigation water, Water reuse, Water policy, Brackish water, Droughts, Water shortage, Water users, Water demand, Water supply.

Following the positive public response to the need for water conservation in California during the drought of 1976-77 an extensive program of planning for future water conservation is being developed. As public awareness of the drought severity developed in 1977, customers in the Marin Municipal Water District decreased their consumption by 64%, 7% more than the mandated 57% reduction. Two major drought measures used were the increased use of reclaimed water, especially for irrigation, and the construction of a temporary pipeline from the East Bay across the Richmond-San Rafael Bridge. A comparison of 1977 and 1979 water usage shows that water conservation practices are persisting although not at the peak drought level. Permanent conservation measures include low-flush toilets and low flow showers and lavatory faucets. A benefit to cost ratio of about five to one was found for implementing conservation equipment. A 15% reduction in demand through conservation is the goal of the State Water Project in Southern California by the year 2000. With cooperation the amount of water used for urban landscape irrigation could be reduced by 1.4 cubic hectometers in the same period. Conservation in agriculture, the largest single water user in California, will involve the increased use of drip irrigation, the use of brackish water for irrigation, and the development of salt-tolerant crops. Water conservation must be a tool for day-to-day operations as well as long-term drought planning. (See also W81-00160) (Seigler-IPA)
W81-00163

WATER CONSERVATION IN NORTHEASTERN ILLINOIS,
Illinois State Dept. of Transportation, Chicago. Div. of Water Resources.
F. L. Kudrna, and D. Injerd.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979. Franklin Pierce College, Rindge, NH. p 47-57, 1979. 7 Ref.

Descriptors: *Illinois, *Water conservation, *Lake Michigan, Water policy, Plannin, Water supply, Water utilization, City planning, Water reuse, Water shortage, Water rates, Humid areas, Wet climates, Water demand.

Water conservation is becoming accepted practice in Northeastern Illinois despite the apparently ample supply of water from Lake Michigan and an annual precipitation average of 33 inches. Litigation limits the amount of water that Illinois can divert from Lake Michigan to 3,200 cfs and other water supply sources in the area are hydrologically limited, thus conservation is a necessity. Three major points in the area's conservation program are: (1) to reduce the amount of lake water required for operation of the Sanitary and Ship Canal; (2) to reduce the water lost through leakage at lakefront controlling works; and (3) to require all entities receiving lake water to implement water conservation techniques. Various water conservation techniques appropriate for Northeastern Illinois include water conservation ordinances, outside water use controls, retrofitting, adjusting water rate structures, water conservation education, industrial water reuse, and low consumption appliances. Steps are also being taken to ensure efficient water systems management. It is difficult to quantify the effects of water conservation techniques and reductions in Illinois will seem minor compared with drought stricken areas like California, but the steps taken here are important in the establishment of a water resource balance for the area. (See also W81-00160) (Seigler-IPA)
W81-00164

THE ECONOMICS OF WATER CONSERVATION,
California Univ., Santa Barbara.
W. D. Morgan.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 93-13, 1979, Franklin Pierce College, Rindge, NH, p 59-68, 1979, 2 Fig, 27 Ref.

Descriptors: *Water conservation, *Economics, *Evaluation, *Cost-benefit analysis, Alternative costs, Water demand, Prices, Water supply, Mathematical models, Input-Output analysis, Forecasting, Water costs, Planning, Water allocation, Water rates.

It is the view of economists that financial incentives are an integral part of determining water use and therefore are an integral factor in water conservation. Economists consider water to be a 'good' and, if provided full information, consumers will choose the correct amount for them given their income or output. Water is scarce, which makes it an economic good, it has declining marginal value, and it is divisible and can be allocated over time and space. A demand curve can be used to show internal information about water supply and demand for a given unit such as a household or industrial firm. A demand curve shows the quantity of water needed at all alternative prices while holding all other influencing factors constant. A framework for the allocation of water is developed using the constraints of supply and demand while considering factors such as specific user group pricing, prices different from marginal costs, seasonal or peak load pricing, and price flexibility. It is important that water purveyors get rid of all subsidies and begin to calculate the real resource cost of the water they supply. Demand management is needed to develop rate structure related to marginal cost pricing. Information must be provided so users can conserve by making wise economic short-run and long-run decisions. (See also W81-00160) (Seigler-IPA)
W81-00165

WATER CONSERVATION IN HOUSING,
Department of Housing and Urban Development, Washington, DC.
J. C. Hancock.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 69-73, 1979.

Descriptors: *Water conservation, *Water policy, *Federal government, *Domestic water, Water costs, Water supply, Water loss, Leakage, Water users, Water shortage, Regulation, Building codes, Legislation.

The draft report of Task Force No 9 of the President's Water Policy Initiatives on 'Water Conservation in Housing Assistance Programs' is summarized. Residential water conservation is to be accomplished at minimal cost and without reducing the quality of life of affected users. The Task Force found that it may be possible to reduce the current 70 gallons per person daily water consumption by as much as 15% within 10 years. Although residential consumption is only a small part of total consumption a visible water conservation effort in housing is essential if a water conservation ethic is to become part of the American way of life. Eight actions are recommended for early implementation including limited flow showerheads, flow aerators on faucets, water leakage surveys, metering of all water distribution pipes, and the modification of government standards. Twenty-two items needing short term research are listed along with fourteen that need long term research for proper evaluation. General factors affecting residential water use conservation that are interrelated with other water conservation considerations include the establishment of a general conservation ethic, land subsidence, domestic water use costs, leakage, and sewage plant operations. (See also W81-00160) (Seigler-IPA)
W81-00166

WATER CONSERVATION IN FEDERAL PROGRAMS,
Office of Water Research and Technology, Washington, DC.
G. D. Cobb.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 74-79, 1979.

Descriptors: *Water conservation, *Water policy, *Federal government, *Programs, Planning, Legislation, Water resources development, Water shortage, Water supply, Federal-State water rights conflicts, Government finance, Federal project policy, Administrative agencies, Water law, Water utilization.

President Carter's water policy statement and first 13 initiatives are designed to make certain that there is enough water of the right quality to meet all of the needs of the American people by placing emphasis on water conservation. Water conservation is defined in many ways such as wise water management or saving water at one place and time to make it available for more beneficial uses. In the past, Federal programs have often been too late, scattered, and uncoordinated. To change this the President has required that all Federal water programs be reassessed, reviewed, and examined for water conservation opportunities. Nineteen Task

Forces are conducting this coordinated analysis of Federal programs and water policy. A Water Policy Coordination Group keeps the Task Forces on schedule and on track. Task Force 6A has compiled a preliminary report of information and recommendations from 87 Federal programs. A matrix was developed to rank the recommendations for the 87 programs. Reclamation rehabilitation was ranked number 1, waste treatment management was ranked number 3, and water resources research was ranked number 14. This effort begun by Task Force 6A must be continued and expanded if water management is to make full use of Federal programs. (See also W81-00160) (Seigler-IPA)
W81-00167

WATER CONSERVATION IN U. S. ARMY CORPS OF ENGINEERS PROGRAMS,
Corps of Engineers, Washington, DC. Office of Policy.
D. B. Duncan.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 80-82, 1979.

Descriptors: *Water conservation, *Water policy, *Federal government, *Corps of Engineers, Water resources development, Reservoirs, Water loss, Environmental effects, Water supply, Planning, Water utilization, Project planning, Project benefits, Alternate planning, Programs.

The Corps of Engineers defines water conservation as any beneficial reduction in water use or in water losses. From this, water management practices constitute conservation only when their purpose is to conserve a given supply of water through reduction in water use (or loss) and when their total national economic and environmental benefits outweigh their costs in these areas. The Corps of Engineers must apply sound conservation principles in the use of water by the agency, and water conservation must become a basic factor in planning to satisfy future water supply needs. To implement water conservation the Civil Works program has five functional areas: planning, design and construction, reservoir regulation, operation and maintenance, and regulatory activities. Planning represents the area with the greatest potential for conservation. Policy studies are currently underway to meet planning needs. Design and construction activities for conservation will be site specific and careful conservation reviews will be conducted during the stages of preauthorization, postauthorization planning, and design. Guidelines have been issued by the Chief of Engineers to improve water management at existing reservoir projects. In the future an evaluation process will be developed to permit a consistent trade-off between water conservation practices and increments of additional water supply. (See also W81-00160) (Seigler-IPA)
W81-00168

WATER SUPPLY SYSTEM FAILURES WITH CONSERVATION,
Camp, Dresser and McKee, Inc., Atlanta, GA. Water Resources Div.
G. S. Nicolson.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 94-102, 1979. 8 Fig, 2 Tab, 2 Ref.

Descriptors: *Water conservation, *Computer models, *Mathematical models, *Droughts, *Forecasting, Reservoirs, Streamflow forecasting, River forecasting, Statistical methods, Water demand, Water shortage, Probability, Synthetic hydrology, Statistical models.

A computer model that smulates streamflow and reservoir operation of an existing water supply reservoir system was used to forecast annual reservoir failures with two sets of demands and situations. The model uses both the historic record and a synthetic record. Water demand from the reservoir is increasing 1 to 2% annually with current withdrawals already exceeding the long-term safe yield. Should the above average rainfall trend of recent years end, or should a drought occur, water conservation measures will have to be taken to reduce demand. The computer model was used to analyze the results of such conservation measures during forecasted droughts. A streamflow model that preserves monthly means, standard deviations, serial correlation coefficient, and skew coefficient was used to generate the one hundred years synthetic record. Demand estimated from the historic record is less than that from the synthetic record for curves of equal probability of failure. A forecasting procedure was used to determine when the water demand should be reduced by conservation. The two simulations run had average demands of 0.85MAF and 0.79MAF. Failure probabilities of more than 20% and 10%, respectively, were found. Results show that for this reservoir system, forecasting and conservation have more impact on reducing failures when the probability of failure is high than when it is low. (See also W81-00160) (Seigler-IPA)
W81-00171

WATER CONSERVATION NEEDS AND APPROACHES IN HUMID AREAS,
North Carolina Water Resources Research Inst., Raleigh.
J. M. Stewart.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 130-136, 1979. 3 Fig, 1 Tab, 3 Ref.

Descriptors: *North Carolina, *Water conservation, *Water policy, *Virginia, Water users, Water demand, Water costs, Industrial water, Humid areas, Wet climates, Water rates, Forecasting, Urbanization.

Despite being a humid water-rich State, North Carolina does have water use problems and conservation steps are being taken. Conservation measures can: (1) reduce treatment and construction costs; (2) reduce energy costs; (3) extend the use of high quality water sources; (4) extend the life of existing facilities; (5) reduce environmental impacts; and (6) improve on-site facility performance with decreased flows. North Carolina has disparities in geographic patterns of water availability and population distribution. Large urban areas are located on divides or on river headwaters. Also, the State has many high water consumption industries. Water use continues to increase annually with 1975 figures showing per capita water use at over 1,200 gallons per day. Water uses are expected to double in the next 40 years. Water conservation is being encouraged by the Environmental Management Commission. A bonus priority system for State grants was established to give priority to applicants who practice water conservation methods. The Atlanta Regional Commission has also adopted specific policies to promote water conservation. In Virginia, the Fairfax County Water Authority has developed a rating schedule to promote conservation and equality by assessing an excess usage charge to customers who use 1.3 times their winter consumption in the summer. (See also W81-00160) (Seigler-IPA)
W81-00175

HUD/NBS RESIDENTIAL WATER CONSERVATION PROGRAM,
National Bureau of Standards, Washington, DC.
L. S. Galowin.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 137-138, 1979.

Descriptors: *Water conservation, *Potable water, *Laboratory tests, Water policy, Cost-benefit analysis, Design criteria, Building codes, Design standards, Specifications, Drainage systems, Plumbing, Pipes, Water demand.

Multi-year laboratory research investigations are being conducted by the National Bureau of Standards to develop standards for water conserving potable water systems in buildings. Included in the research are the total building plumbing system, water supply distribution, fixtures, waste drainage branches, and other treatment facilities. The research is designed to establish: (1) test methods for buildings; (2) guidelines of performance for plumbing codes; (3) Minimum Property Specification water reduction provisions; (4) acceptance factors throgh human factors research; and (5) economic evaluation procedures. The research is categorized into the following areas: water efficient fixtures technology; demand for water; efficiency of drainage systems; drainage, waste, vent systems; and usage and acceptability factors. These categories are briefly described. (See also W81-00160) (Seigler-IPA)
W81-00176

NORTHERN CALIFORNIA RATIONING LESSONS,
North Marin County Water District, Novato, CA.
J. O. Nelson.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 139-146, 1979. 2 Fig, 2 Ref.

Descriptors: *California, *Water conservation, *Rationing(Water), *Water shortage, Droughts, Water supply, Irrigation water, Industrial water, Plumbing, Water management(Applied), Regulation, Water rates, Arid lands.

Evidence collected in connection with the California drought indicates that in a similar area, given a serious water shortage and adequate communication with the consumers, a reduction in water use of between 25 and 40% can be achieved when an emergency rationing plan for residential water consumption is implemented. Under these conditions reductions in commercial consumption of up to 25% are also possible. Rationing involves critical allocation decisions so that the least harm possible will result. In nearly every instance where mandatory rationing was implemented in California, Consumers cut water usage even more than requested. Communication is the key to rationing so that the consumer makes a voluntary commitment. Four distinct rationing forms were used: (1) percentage reduction (compared to normal use in a similar billing period); (2) seasonal allotment (a per capita or per home allotment -- increased in summer and decreased in winter); (3) fixed allotment (per capita or home allotment based on calculated need); and (4) sprinkler ban. Overall it was concluded that under drought conditions rate penalties for exceeding allotments were not needed. Most programs provide for service shut off in the event of repeated violations. The total sprinkler ban was found to be the least successful method. (See also W81-00160) (Seigler-IPA)
W81-00177

DENVER -- IMPORT AND REUSE CONSERVATION LESSONS,
Denver Water Dept., CO.
R. D. Wiley.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 165-173, 1979. 5 Fig, 4 Ref.

Descriptors: *Water conservation, *Colorado, *Denver, *Colorado River, Water supply, Water utilization, Water demand, Successive use, Environmental effects, Planning, Water resources development, City planning, Urbanization, Semiarid climates.

The Denver Water Department which provides treated water service to over 900,000 people is having to make hard decisions concerning the realities of conservation versus the expense and environmental unpopularity of further development of Colorado River waters. Denver, located on a semiarid plain, has an average rainfall of only 15 inches. Approximately 70% of Colorado's surface water flows away from Denver down the sparcely populated Western Slope of the Continental Divide. The South Platte River, which flows past Denver, collects only 10% of the State's water. At present Denver gets 60% of its water supply by diverting water flow from the Western Slope. There is much

negative sentiment concerning future increases in diversion from the Western Slope and the Colorado River. One conservation measure being conducted is successive use or reuse. A one million gallon-per-day reuse demonstration plant is being designed for future construction. A full-scale reuse program could be implemented by about the year 2000 if the demonstration plant is successful. Even with conservation and successive use the demand for water will exceed supply sometime around the turn of the century. Also, if water rights to Western Slope water are not utilized they will be lost to downstream urban areas. (See also W81-00160) (Seigler-IPA)
W81-00180

CONSERVATION BETWEEN AND BEYOND DROUGHTS,
Bureau of Land Management, Washington, DC.
J. E. Sabadell.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 196-201, 1979. 3 Fig, 1 Tab.

Descriptors: *Droughts, *Water conservation, *California, Planning, Industrial water, Agriculture, Water resources deve lopment, Social aspects, Water utilization, Urbanization, Domestic water, Political aspects, Environmental effects.

The California drought of 1976-1977 demonstrated that water conservation can be quite successful in urban areas. The highest reductions were achieved in the residential sector, however, consumers are slowly returning to pre-drought consumption behavior. Residential water consumption is returning to normal more slowly than consumption in commercial, industrial, and agricultural activities. Even at the height of the drought, the agricultural sector reacted mainly to economic pressures for water conservation. Four conclusions drawn from these facts are: (1) the inevitability of droughts should be recognized and should be an integral part of planning; (2) the manipulation of nature conditions is limited by ecological impacts, and by economic, social, and political factors; (3) many systems are operating at their carrying capacity and have no resilience; and (4) there is too little concern about future droughts once a crisis period has passed. The Bureau of Reclamation has identified a priority list of actual and future water problems for the 11 Western States. Problems on the list include water for energy resources development, water for Indians, Colorado River water supply and salinity, water conservation and reuse, protection of estuaries, and preservation versus development. (See also W81-00160) (Seigler-IPA)
W81-00183

EFFECTS OF CONSERVATION MEASURES ON WATER DEMANDS,
Camp, Dresser and McKee Inc., Springfield, VA.
R. S. Taylor.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 202-203, 1979.

Descriptors: *Washington(DC), *Water conservation, *Urbanization, Water shortage, Droughts, Domestic water, Social aspects, Economic analysis, Water utilization, Forecasting, Mathematical models, Regression analysis, Planning.

An evaluation of the impacts of different levels of water shortages on different classes of users and the ability of conservation to minimize these shortages was conducted for the Metropolitan Washington Area (MWA) by the Baltimore District, Corps of Engineers. This evaluation is briefly summarized. Eight subregional areas were identified to simplify the evaluation. Water use in the MWA is 66% residential, 11% commercial/industrial, and 14% governmental. Due to the high percentage of residential use, any program of water conservation must involve residential users at a high level of participation. Several alternative conservation 'scenarios' were developed with future water demands to demonstrate the relative effectiveness of conservation techniques. The methodology used for these projections involved current water use levels, projected population, employment, and housing. Water demand is estimated in each of the five major user categories from 1980 to 2030 in 10-year increments. Short-term responses to an expected water shortage in the MWA were also developed and economic losses and social impacts are analyzed. (See also W81-00160) (Seigler-IPA)
W81-00184

THE FEDERAL OVERVIEWER -- BUREAU OF WATER CONSERVATION,
Texas Tech Univ., Lubbock. Water Resources Center.
R. M. Sweazy.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 245-250, 1979.

Descriptors: *Federal Government, *Water conservation, *Water policy, Planning, Legislation, Water resources development, Federal-State water rights conflicts, Government finance, Water rights, Water demand, Water supply, Cost-benefit analysis, Environmental effects, Decision making.

Water conservation when properly implemented is highly desirable, however, a new or modified Federal Government bureau to prepare and enforce detailed universally-applicable regulations is not desirable. If there is to be a defined Federal policy it should include consideration of the supply and demand and both should be subjected to cost-benefit analyses. In general the existing Federal agencies such as the Corps of Engineers, the Bureau of Reclamation, and the Soil Conservation Service have done a good job and are adequate to handle future water policy objectives. States should set their own water policy with as little Federal encroachment as possible. Any Federal Government water conservation policy should have as its cornerstone a sound recognition of State priority in water management. The Federal Government can aid states by providing incentives to sound conservation and eliminating disincentives. Federally financed projects should set prices to discourage the excessive use of water. It is also possible that through the Water Resources Council the Federal Government could provide an information and assistance clearinghouse to promote water conservation. (See also W81-00160) (Seigler-IPA)
W81-00189

3E. Conservation In Industry

LOW-COST EVAPORATION CONTROL USING WAX IMPREGNATED FOAM,
Arizona Univ., Tucson. Water Resources Research Inst.
C. B. Cluff, L. Onyskow, F. Putman, S. Chesser, and D. Powelson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-116832, Price codes: A03 in paper copy, A01 in microfiche. Project Completion Report, September, 1980. 28 p, 11 Fig, 7 Tab, 11 Ref. OWRT-A-091-ARIZ(1), 14-34-0001-8003.

Descriptors: *Evaporation control, *Reservoir evaporation, *Water conservation, *Floats, *Plastics, Water proofing, Concretes, Joints(Connections), Design, Engineering structures, Engineering, Equipment, Evaporation, Alcohols, Thin films, Floating, Polymers, Research and development, Reservoirs, Water management(Applied), Water loss, Water quality, Moisture proofing, Coatings.

A one-year study was conducted on the development of improved methods of water evaporation control using wax impregnated foam. Expanded polystyrene (EP) foam and 140 degrees F melting paraffin were used. A pressure chamber was used to wax impregnate EP sheets. Laboratory tests led to modification of the pressure chamber into a vacuum chamber, but problems arose in impregnating the interior of the sheets using a vacuum. The pressure model, however, was successfully used to impregnate up to 3-inch thick sheets of EP. It was also observed that the paraffin-impregnated rafts worked very well until temperatures above 100 degrees F were encountered under dusty conditions. Such high temperatures caused the waxed surface to become tacky, and the dust darkened the otherwise white surface, which in turn captured more heat and then more dust. Higher melting point waxes were studied to reduce the accelerated weathering noted at high temperatures, but no satisfactory combinations were found. Use of a high melting (near 190 degrees) polyethylene copolymer wax was too viscous for impregnation, but provided a hard surface coating when previously wax impregnated EP sheets were dipped into the molten polyethylene wax. Development study on wax impregnated lightweight concrete rafts, and connecting rafts with sheet metal strips bonded to EP, was also reported. (Zielinski-IPA)
W81-00112

PROCEEDINGS OF THE CONFERENCE ON WATER CONSERVATION NEEDS AND IMPLEMENTING STRATEGIES,
For primary bibliographic entry see Field 3D.
W81-00160

ULTRAFILTRATION SYSTEM PAYS FOR ITSELF,
Abcor, Inc., Wilmington, MA.
S. Pinto, and L. Gould.
Industrial Wastes, Vol 26, No 5, p 16-18, September/October, 1980. 3 Fig, 1 Tab.

Descriptors: *Filtration, *Semipermeable membranes, *Cleaning, *Metals, *Alkaline cleaner baths, Industrial plants, Costs, Water pollution, Industrial wastes, Waste treatment, Conservation.

An ultrafiltration system in an alkaline cleaner bath used for metal pretreatment is described. Ultrafiltration is a pressure-driven process for separating high-molecular-weight solutes or colloids from water solutions using a semipermeable membrane. The use of such a system reduces chemical costs by increasing bath life and reducing dumping frequency, improves parts cleaning by removing soil from the bath, reduces cleaner bath maintenance, and reduces pollution caused by cleaner bath disposal. The purpose of the system is to remove oil and solids from the bath. The ultrafilter serves as a 'kidney' on the alkaline cleaner bath. The system consists of a processing tank, ultrafiltration membranes, heat exchanger, and washing tank. Solid cleaner feed feeds through the system, continuously recycling through the membrane tubes and returning to the process tank. The maximum length of the ultrafiltration process cycle is related to tank size, permeation rates, and cleaner soil content, which will differ for each system. (Baker-FRC)
W81-00230

3F. Conservation In Agriculture

INCENTIVES FOR AGRICULTURAL WATER CONSERVATION,
Sonnen (M. B.) Co., Inc., Walnut Creek, CA.
M. B. Sonnen, B. B. Dendy, and K. P. Lindstrom.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-109787, Price codes: A06 in paper copy, A01 in microfiche. Report prepared for Office of Water Research and Technology, July 1980, 108 p, 3 Fig, 13 Tab, 44 Ref, Append. OWRT-C-90134-C(No 9428)(1), 14-34-0001-9428.

Descriptors: *Water conservation, *Irrigation, *Water resources development, *Water management, Agriculture, Ground water, Droughts, Planning, Competing uses, * Legal aspects, Economics, Surface waters, California, Texas, Water policy, *El Paso, *San Joaquin Valley, *Sacramento River Valley, Western U.S. water supplies, Water conservation methods, Economic incentives.

Four water districts and thirteen individual farmers were interviewed about their current water conservation methods and possible incentives that might be instituted to encourage still further water sav-

ings. Interviewees farmed in central California and west Texas, and all were using both Federally supplied surface water and local ground water. These farmers were all using several methods of conservation. Tail-water return systems and laser-controlled land leveling were the most prevalent. Farmers agreed that conservation is feasible to a point; it is done in reaction to economic forces; and it will eventually have to be supplemented with additional water supply developments. One of many conclusions drawn was that water conservation as one element in overall water management planning policy could be defended and was worthwhile, whereas a policy of having water conservation take the place of needed additional water development projects could not be sustained. Additionally, water savings among western U.S. irrigators through conservation could not be relied upon to reduce total water withdrawals over current amounts by more than roughly 15%, because western farmers have been using water sparingly for many years.
W81-00003

ECONOMIC POTENTIALS FOR AGRICULTURAL WATER-SAVING USING ALTERNATIVE IRRIGATION TECHNIQUES,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
H. J. Vaux, Jr., and A. W. Marsh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-112732, Price codes: A03 in paper copy. California Water Resources Center, University of California, Davis Technical Completion Report, September 1980, 43 p, 2 Tab, 1 Appen. (California Water Resources Center Project UCAL-WRC-W-553). OWRT-A-072-CAL (1).

Descriptors: *Irrigation efficiency, *Irrigation practices, *Irrigation systems, *Economic efficiency, Energy, Linear programming, Pumping, Stress, Agriculture, Adoption of practices, Model studies, *California.

More efficient use of water used by irrigated agriculture in California will likely be necessary if the significant economic role played by this industry is to be maintained in the future. Necessary economic data and methodologies are developed to assess the extent to which water savings can be realized through widespread adoption of water-saving irrigation technologies. Special emphasis is placed on identifying the extent to which water saving irrigation technologies substitute energy for water. An assessment of the methods developed was performed on the agricultural sector of western Riverside county of southern California. A linear program model develops the responses of agricultrual production to changes in the cost and availability of irrigation water and pumping energy. A new method for limiting cropping pattern shifts is analyzed. The results of the model and the possible impact of the model's assumptions on these results are discussed. Some conclusions drawn from the analysis include: an increasing rate of decline in irrigated acreage, particularly of field crops, due to increasing resource prices; a much higher eleasticity of demand for imported water than for ground water; increasing use of sprinkler and particularly drip irrigation as water price rises; and a large potential for water stressing of crops if better information becomes available on water production functions. Implications of the results are discussed and ways of improving the accuracy of the model are suggested. (Snyder - Calif)
W81-00024

IMPACT OF ALTERNATIVE ENERGY PRICES, TENURE ARRANGEMENTS & IRRIGATION TECHNOLOGIES ON A TYPICAL TEXAS HIGH PLAINS FARM,
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.
J. A. Petty, R. D. Lacewell, D. C. Hardin, and R. E. Whitson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-112674, Price codes: A13 in paper copy. Texas Water Resources Institute, Texas A & M University Technical Report No 106, May 1980. 269 p, 32 Tab, 20 Fig, 79 Ref, 4 Append. OWRT-A-045-TEX (1), 14-34-0001-9046 & 0146.

Descriptors: *Irrigation, *Crop production, *Irrigation wells, *Costs, *Irrigation operation and maintenance, Pumping, Irrigation efficiency, Technology, Irrigation fuel, *Texas High Plains.

Irrigation is a major contributing factor in crop production on the Texas High Plains. A recursive linear programming model for a typical Texas High Plains irrigated farm was developed to evaluate expected impact of price changes, tenure and new technology. Model results indicate that irrigation would be terminated when the price of natural gas reached about $7.00 per mcf. Annual returns (above variable and fixed costs) were reduced by about as much as 30%, and the present value of returns to water was reduced by as much as 80% as the natural gas price was increased annually by $0.25 per mcf (from $1.50 per mcf). The economic life of deep groundwater was shortened by as much as 18 years. Renter-operators are even more vulnerable to rising natural gas prices than are owner-operators. Substantial economic gains appear feasible through improved pump efficiency. Results indicate that irrigation can be extended by 11 or more years with 50% improved distribution efficiency. In addition, the increase in present value of groundwater on the 1.69 million irrigated acres of the Texas High Plains was estimated to be $995 million with 50% improved efficiency.
W81-00032

A LINEAR PROGRAMMING MODEL OF AGRICULTURAL ACTIVITY AND RESOURCE USE UNDER CHANGING RESOURCE CONDITIONS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
S. A. Hatchett.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-115693, Price codes: A06 in paper copy, A01 in microfiche. Master of Administration, Thesis, August 1980. 114 p, 14 Fig, 12 Tab, 2 Append. (California Water Resources Center Project UCAL-WRC-W-553).

Descriptors: *Irrigation water, *Agriculture, *Pumping, *Energy, *Costs, Linear programming, Mathematical models, Crop production, California, Sprinkler irrigation, Drip irrigation, Elasticity of demand, Irrigation efficiency.

The response of agricultural production to changes in the cost and availability of irrigation water and pumping energy is analyzed. A linear program is developed to model these responses for the Western Riverside County area of Southern California. A new method for limiting cropping pattern shifts is postulated and analyzed. The results of the model and the possible impact of the model's assumptions on these results are discussed. Some conclusions drawn from the analysis include: an increasing rate of decline in irrigated acreage, particularly of field crops, due to increasing resource prices; a much higher elasticity of demand for imported water than for ground water; increasing use of sprinkler and particularly drip irrigation as water price rises; a large potential for water stressing of crops if better information becomes available on water production functions. Implications of the results for resource planners are discussed, and ways of improving the accuracy of the model are suggested. (Snyder-Calif)
W81-00083

AN ANALYSIS OF THE PLANT SOIL CONTINUUM USING ELECTROPHYTOGRAMS,
Arizona Univ., Tucson. Dept. of Electrical Engineering.
W. Gensler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-116824, Price codes: A05 in paper copy, A01 in microfiche. Project Completion Report, September 1980. 76 p, 27 Fig, 7 Tab, 7 Ref, 1 Append. OWRT-B-061-ARIZ(1), 14-34-001-858.

Descriptors: *Electrodes, *Electrical conductance, *Soil moisture, Irrigation practices, *Irrigation efficiency, *Cotton, *Pecans, Electrical properties, Conductivity, Soil physical properties, Soil water, Moisture content, Moisture availability, Soil moisture meters, Irrigation water, Irrigation programs, Water utilization, Water supply, Water conservation, Water control, Irrigation systems, Crops, Analysis, Analytical techniques.

While visual observation is the most widely employed method of deciding when to irrigate, there is a definite need for development of a meaningful and reliable instrumentation system to obtain background data for water application decisions. Direct electrical measurement by the electrophytogram technique was early reported to provide a relation between plant water status and electropotential activity. The basic objective of this study was to quantify this relation such that irrigation schedules could be predicted. A remote sensing capability was established to determine the relation between agricultural water usage and plant electropotentials at two commercial farming sites and an experimental university site in southern Arizona, with plant electropotential activity monitored during successive irrigation cycles in cotton and pecans. These plants were found to have a definite electrical response to changes in water status. A quantitative relation to predict irrigation schedules is presently being developed with these data. Systemic plant electropotential responses were also observed, indicating the existence of a regulatory physiological mechanism over widely separated parts of the plant. Further, fruition of the cotton boll was related to the electropotential response over the long term, suggesting use of electropotential data to predict harvest timing. (Zielinski-IPA)
W81-00111

IRRIGATION PIPE GATE VALVE,
L. W. Clements.
U.S. Patent No 4,190,232, 5 p, 9 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 991, No 4, p 1276, February 26, 1980.

Descriptors: *Patents, *Irrigation, *Application equipment, Valves, Control, Irrigation efficiency, Irrigation operation and maintenance.

An irrigation pipe laying crosswise of a series of furrows has gate valves mounted in its side spaced to match each furrow. Each gate valve includes a generally elliptical, elastomeric, grommet-like frame fitting on the periphery of a recessed lip portion of the pipe defining an opening, and also includes a tubular slide slidable in the frame between a closed position and three open positions, one perpendicular to the pipe and two others cocked to either side to direct water to the outer of the three furrows. (Sinha-OEIS)
W81-00125

PROCEEDINGS OF THE CONFERENCE ON WATER CONSERVATION NEEDS AND IMPLEMENTING STRATEGIES,
For primary bibliographic entry see Field 3D.
W81-00160

HYDROLOGY AND POLITICAL INFLUENCES ON WATER SUPPLY,
Harza Engineering Co., Chicago, IL.
J. E. Priest.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 83-87, 1979.

Descriptors: *Political aspects, *Water conservation, *Hydrologic aspects, *Urban hydrology, Watersheds(Basins), Lake Michigan, Illinois, Runoff, Recharge, Groundwater, Water measurement, Water allocation policy, Decision making, Indus Basin System.

Three representative programs are discussed to show that while hydrologic analyses are imprecise and generate controversy and conflict, they do aid in the implementation of needed water supply and conservation measures. Factors to be considered in dealing with the hydrology of an allocation system include measuring the supply, identifying a base

period for supply estimates, forecasting supply and conservation changes, and selecting an equitable allocating base. The Indus Basin System, with agricultural related conservation needs measured in tens of millions of acre feet is used to illustrate how hydrology issues enter into the allocation and conservation process. Other examples used are the urban northern Illinois area with a Great Lakes diversion totalling over 2 million acre feet annually, and the Lake Minnetonka watershed near Minneapolis with a delicate hydrologic balance having only a few thousand acre feet of runoff. Hydrologists work will continue to be controversial due to the importance of opinion and judgement. Hydrologists will continue to make the best estimates possible to implement beneficial programs while providing as much flexibility for the future as possible. (See also W81-00160) (Seigler-IPA)
W81-00169

PERSPECTIVES ON AGRICULTURAL WATER USE AND CONSERVATION,
Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
P. E. Fischbach.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 122-129, 1979. 6 Tab.

Descriptors: *Irrigation efficiency, *Water conservation, *Irrigation water, *Nebraska, *Irrigation systems, Energy, Cost analysis, Irrigation practices, Crop production, Scheduling, Leaching, Soil water, Root zone, Deep percolation.

Irrigation statistics for 1973 indicate that Nebraska irrigators used 617.8 million kilowatts of electricity, 101 million gallons of diesel fuel, 53.5 million gallons of LP gas, and 5,738 million cubic feet of natural gas to power irrigation pumping plants. Also, most irrigation systems have excess capacity that farmers use to apply unneeded water. Many systems are run nearly continuously during the growing season regardless of rainfall or soil conditions. Irrigation water losses due to runoff or deep percolation represent excess energy requirements. Irrigation systems have different energy requirements with the gated pipe system being the most efficient for Nebraska. New automatic irrigation systems along with improved irrigation management procedures could result in a 37% energy savings over present usage. Nitrate leaching, loss of nitrogen from the root zone, can also occur when excessive irrigation water is used. Increment feeding through the irrigation system could help to reduce this loss. Correct irrigation scheduling could save 35% of the water now used. At present energy prices, a gated pipe system could save $16.50 per acre with good scheduling and a center pivot system could save $28.30 per acre. At $2.00 an acre inch for water the savings here would add another $14.60 per acre. A technology transfer program is needed to train irrigators and consultants in these conservation measures. (See also W81-00160) (Seigler-IPA)
W81-00174

DROUGHT LESSONS FROM AGRICULTURE,
Utah State Univ., Logan. Dept. of Economics.
H. H. Fullerton.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979. Franklin Pierce College, Rindge, NH, p 174-181, 1979.

Descriptors: *Agriculture, *Droughts, *Water conservation, *Water policy, Forecasting, Government supports, Drought tolerance, Water supply, Management, Planning, Economics, Water allocation, Water shortage, Water resources development.

The impact that modifications in institutions, management, and policy will have on water conservation will depend greatly on their long-run economic feasibility. Severe droughts in the 1930's and 1970's have produced the following observations: (1) drought prediction within a timeframe useful for planning is virtually nonexistent; (2) estimated drought damages are in general grossly overstated; (3) in almost all cases alternative water sources are less energy efficient than traditional supplies; (4) agricultural prospectives differ greatly from individual producer and consumer perspectives; (5) water resource flexibility is directly related to property rights; (6) governmental expansions can be justified on egalitarian grounds; (7) drought mitigating practices may have serious long-run consequences; (8) drought conditions complicate use efficiency; and (9) drought research cannot be studied as an isolated problem. Little can be gained by continuing to isolate drought from other areas such as meteorology, water management, and land/water interrelationships. This is especially true when drought study financing is being sought. Drought provides lessons by causing us to reexamine our conventional wisdom and by forcing us to give research attention to the fuller utilization of data and research information for immediate management and policy decisions. (See also W81-00160) (Seigler-IPA)
W81-00181

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

EFFECTS OF STREAM CHANNELIZATION ON BOTTOMLAND AND SWAMP FOREST ECOSYSTEMS,
North Carolina State Univ. at Raleigh. School of Forest Resources.
T. E. Maki, A. J. Weber, D. W. Hazel, S. C. Hunter, and B. T. Hyberg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-111429, Price codes: A09 in paper copy, A01 in microfiche. Research Institute of The University of North Carolina, Raleigh, Report No 147, 1980, 135 p, 26 Fig, 22 Tab, 4 Append. OWRT-B-094-NC (4), 14-34-0001-6107.

Descriptors: Silviculture, *Channeling, *Environmental effects, Channel improvement, *Swamps, *Ecosystems, Surface drainage, Vegetation regrowth, Drainage effects, Streamflow, Wetlands, *Forests, *North Carolina.

An investigation was undertaken to determine the effects of stream channelization on the bottomland-swamp forest ecosystems of Eastern North Carolina. The ground water regimes in the floodplains of cutover and non-cut areas of four channelized streams and seven non-channelized streams were monitored by means of lines of wells positioned perpendicular to each stream channel. The water levels in the wells were measured weekly between January 1975 and July 1977, providing the basis on which the plant communities of the cut and non-cut, channelized and non-channelized swamps could be compared. Growth studies indicated that channelization resulting in moderate average summer water levels was not necessarily detrimental to mature tree growth, including that of 'water loving' species such as water tupelo, swamp blackgum, and bald cypress. Evidence of severe dieback or loss of vigor was noted in trees along the channelized streams only in the few observed instances where water had been backed up by spoil material into stagnant pools or where several feet of soil had been piled against the bases of the trees. A midsummer count showed four times more small tree stems per hectare in the non-channelized areas than in the channelized areas. Survival and growth of planted water tupelo seedlings was notably greater along the non-channelized streams.
W81-00036

HYDROLOGY AND WATER QUALITY OF THE LOWER MISSISSIPPI RIVER,
Geological Survey, Baton Rouge, LA. Water Resources Div.
F. C. Wells.
Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report No 21, 1980. 82 p, 26 Fig, 5 Plates, 17 Tab, 50 Revf.

Descriptors: *Water quality, *Streamflow, *Discharge(Water), *Sediment transport, *Louisiana, Mississippi River, Flow rates, Chemical analysis, Water temperature, Bacteria, Heavy metals, Dissolved oxygen, Organic compounds, Pesticides, Path of pollutants, Benthos, Water utilization, Time of travel, *Lower Mississippi River(LA).

Average discharges for the Mississippi River at Vicksburg, Miss., and Red River-Tarbert Landing are 573,600 and 461,000 cubic feet per second, respectively. An average suspended-sediment load of 630,000 tons per day is transported past Red River-Tarbert Landing; approximately 77 percent as silf and clay. Concentrations of dissolved solids at St. Francisville and Luling, La., are less than 300 milligrams per liter 90 percnet of the time. Concentrations of trace metals are within the recommended limits for public-water-supply sources 99 percent of the time. Dissolved-oxygen concentrations exceed 75-percent saturation 90 percent of the time. DDT, dieldrin, endrin, diaxinon, 2,4-D are the most frequently detected pesticides. Concentrations of volatile organic compounds are generally less than 10 micrograms per liter, and concentrations of 14 semivolatile organic compounds have generally been less than 5 milligrams per liter. The most common and numerous benthic organisms collected are Corbidula and tubificid worms. An average of 6,300 million gallons per day of water was withdrawn from the river below St. Francisville in 1975 for industrial and municipal uses. Average decomposition rates for the Mississippi River ranged from 0.046 to 0.058 (per day, base e). (USGS)
W81-00064

THE EFFECTS OF USING GROUND WATER TO MAINTAIN WATER LEVELS OF CEDAR LAKE, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2H.
W81-00066

EFFECT OF FLUCTUATING RESERVOIR RELEASE ON THE DOWNSTREAM ENVIRONMENT,
Michigan Technological Univ., Houghton. Dept. of Biological Sciences.
K. J. Kraft, and N. D. Mundahl.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-115677, Price codes: A02 in paper copy, A01 in microfiche. Institute of Water Research, Michigan State University, East Lansing, Project Completion Report, August, 1980, 17 p, 4 Fig, 8 Tab, 136 Ref. OWRT A-105-MICH(1), 14-34-001-9024, 0124.

Descriptors: *Sturgeon River(MI), *Reservoir releases, *Environmental effects, *Downstream, *Water quality, Benthic fauna, Benthos, Turbidity, Water temperature, Powerplants.

Temperature, depth, width, current velocity, turbidity, conductivity, and benthic macroinvertebrates were examined for one year above and below the Prickett Generating Station on the Sturgeon River. For most of the year this generating station operated during the day and shut down at night and on weekends. On days with on-off generator operation, downstream diurnal temperature ranges were similar to those upstream, but on days with continuous generation downstream temperatures for at least 10 km remained relatively constant. The maximum temperature upstream was 22C, 200 m downstream 24.5C, and 10 km downstream 23C. Current during generation more than doubled at 200 m downstream, but increased only slightly 10 km downstream. Depth during generation increased 75 cm at 200 m downstream and 40 cm 10 km downstream. Width during generation increased 7 to 10 m. Turbidity ranged from 7 to 12 ppm SiO2 and conductivity from 120 to 150 micro mhos/cm. Invertebrate density and biomass were lowest in May and highest in September and October. At 200 m downstream density averaged 5.6 x greater and biomass 6.9 x greater than upstream.

At 10 km downstream density averaged 2.4 x and biomass 1.7 x greater than upstream. The total number of taxa collected upstream was 56, at 200 m downstream 50, and 10 km downstream 61. A large, diverse benthic macroinvertebrate community occurred immediately downstream from the generating station suggesting that the on-off mode of generation may be less detrimental to downstream biota than continuous operation which dampens normal diurnal temperature fluctuations and delays seasonal temperature changes.
W81-00087

HYDROLOGY OF THE CHICOD CREEK BASIN, NORTH CAROLINA, PRIOR TO CHANNEL IMPROVEMENTS,
Geological Survey, Raleigh, NC. Water Resources Div.
C. E. Simmons, and M. C. Aldridge.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, paper copy $4.00, microfiche $3.50. Geological Survey Open-File Report 80-680, 1980. 27 p, 9 Fig, 8 Tab, 8 Ref.

Descriptors: *Effects, *Excavation, *Channel improvement, *Watersheds(Basins), *North Carolina, Data collections, Observation wells, Streamflow, Flood flow, Storm runoff, Surface groundwater relationships, Base flow, Water quality, Nutrients, Pesticides, Bacteria, Water pollution sources, *Chicod Creek basin(NC).

Extensive modification and excavation of stream channels in the 6--square mile Chicod Creek basin began in mid-1979 to reduce flooding and improve stream runoff conditions. The effects of channel improvements on this Coastal Pain basin's hydrology will be determined from data collected prior to, during, and for several years following channel alternations. This report summarizes the findings of data collected prior to these improvements. During the 3-year study period, flow data collected from four stream gaging stations in the basin show that streams are dry approximately 10 percent of the time. Chemical analyses of water samples from the streams and from eight shallow groundwater observation wells indicate that water discharge from the surficial aquifer is the primary source of streamflow during rainless periods. Concentrations of Kjeldahl nitrogen, total nitrogen, and total phosphorus were often 5 to 10 times greater at Chicod Creek sites than those at nearby baseline sites. It is probable that runoff from farming and livestock operations contributes significantly to these elevated concentrations in Chicod Creek. The only pesticides detected in stream water were low levels of DDT and dieldrin, which occurred during storm runoff. A much wider range of pesticides, however, are found associated with streambed materials. The ratio of fecal coliform counts to those of fecal streptococcus indicate that the streams receive fecal wastes from livestock and poultry operations. (USGS)
W81-00154

DRAINAGE FOR AN INDUSTRY/OFFICE COMPLEX,
Halff (Albert H.) Associates, Inc., Dallas, TX.
J. I. Novoa, and M. K. Koesling.
Public Works, Vol 111, No 10, p 64-65, October, 1980. 2 Fig.

Descriptors: *Flood plains, *Land reclamation, *Sumps, *Drainage engineering, *Sewers, Storm drains, Construction, Industrial plants, Excavation, Landscaping, Flood control, Land management, Texas.

A well planned office and industrial center was built in the reclaimed flood plain of the Elm Fork of the Trinity River in Texas. The district required construction of sumps within the subdivision to provide flood storage and installation of improved water mains, sanitary sewers, and storm sewers. The sump also was to provide an outlet for all other storm sewers. A reduced cost for storm sewers, an increased sump-storage capacity, the utilization of excess sump excavation to construct positive site drainage, and an attractive landscape were among the benefits derived from this design. (Baker-FRC)
W81-00211

4B. Groundwater Management

INCENTIVES FOR AGRICULTURAL WATER CONSERVATION,
Sonnen (M. B.) Co., Inc., Walnut Creek, CA.
For primary bibliographic entry see Field 3F.
W81-00003

RELATIONSHIPS OF DISSOLVED OXYGEN AND BIOCHEMICAL OXYGEN DEMAND IN SEWAGE EFFLUENT RELEASES,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
P. G. Sebenik.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-115206, Price codes: A05 in paper copy, A01 in microfiche. M.S. Thesis, 1975. 71 p, 8 Fig, 11 Tab, 24 Ref, 2 Append. OWRT A-051-ARIZ(1), 14-31-0001-5003.

Descriptors: *Ephemeral streams, *Open channel flow, *Physicochemical properties, *Sewage effluents, Southwest U.S., Dissolved oxygen, Biochemical oxygen demand, Streamflow, Water quality, Path of pollutants, Groundwater, Seepage.C.

Bio-physicochemical measurements were made on treated sewage effluent releases at established locations within the channel of an ephemeral stream, the Santa Cruz River of Southern Arizona. Water quality samples were taken in chronological sequence, so that incremental flows at low and high hydrograph stages could be traced as the effluent moved downstream. Results indicate that DO concentrations at low effluent flows were higher than DO concentrations at high effluent flows; while, conversely, BOD concentrations at low effluent flows were generally lower than BOD concentrations at high effluent flows. Biochemical oxygen demand concentrations are affected by waste loadings, flow conditions, phytoplankton growth and nitrification. Mean river deoxygenation rates (kr) in sewage flows after six river miles from the Tucson Sewage Treatment Plant were always negative or increasing, which is probably due to nitrification, algal growth, and concentration of organic constituents through seepage losses.
W81-00088

A SUMMARY REPORT. SOUTHEAST CONFERENCE ON GROUND WATER MANAGEMENT, BIRMINGHAM, ALABAMA, JANUARY 30-31, 1980,
D. H. Howells.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-119489, Price codes: A03 in paper copy, A01 in microfiche. Southeast Water Resources, Vol 2, No 2, Fall 1980. University of North Carolina Water Resources Research Institute, Chapel Hill, NC, 42 p. OWRT-B-123-NC(7), B-125-NC(6).

Descriptors: *Water management(Applied), *Groundwater resources, *Groundwater, *Conferences, *Water resources institute, Water utilization, Groundwater availability, Water pollution, Mathematical models, Water policy, Legislation, Waste water treatment, Runoff, Water resources, Water resources development, Planning, State governments, Southeast U.S., Alabama, Florida, Georgia, North Carolina, South Carolina, Tennessee, Virginia.

A summary report is given on a conference on Groundwater Management, the fourth in a series of invitational regional conferences on significant water resource problems of the Southeast. The objectives of this conference were to explore the strengths/weaknesses of State programs related to groundwater management and to identify/describe remedies in areas of legislation, administrative procedures, funding levels, research, technology transfer and education. Summaries contained in this report were taken from papers presented under categories on State groundwater programs/problems (covering Alabama, Florida, Georgia, North Carolina, South Carolina, Tennessee and Virginia), national policy, mathematical modeling for groundwater management, conjunctive management of ground and surface water, organic chemical pollution, well injection of wastes and runoff, waste water treatment for groundwater quality protection, and new programs in surface mining hydrology. General conclusions and recommendations on State programs and problems are summarized. (Zielinski-IPA)
W81-00122

GEOLOGIC AND HYDROLOGIC DATA FROM A TEST-MONITOR WELL AT FERNANDINA BEACH, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
D. P. Brown.
Available from OFSS,USGS Box 254 25, Fed. Ctr. Denver CO 80225, paper copy $5.00, microfiche $3.50. Geological Survey Open-File Report 80-347, 1980. 36 p, 13 Fig, 7 Tab, 3 Ref.

Descriptors: *Hydrogeology, *Hydrologic data, *Test wells, *Groundwater, *Water quality, Water yield, Observation wells, Drilling, Sampling, Stratigraphy, Logging(Recording), Water analysis, Temperature, Aquifers, Florida, *Nassau County(FL), *Floridan aquifer(FL).

A 2,102-foot observation well was drilled at Fernandina Beach, Florida, to obtain geologic and hydrologic data. Drill cuttings, water samples, and water-level measurements were collected. Geologist's, driller's, and geophysical logs were completed. The well is constructed with 12-inch diameter casing to a depth of 515 feet and 6-inch diameter casing from 515 to 2,000 feet. The remainder is open hole. The uppermost 500 feet of material penetrated by the well consists of sand, clay, limestone, and dolomite. In the remainder of the hole, the material consists of fragmental and granular limestone and massive to finely crystalline dolomite, which comprise the Floridan aquifer in the area. After the well was completed, water levels in the monitored zone, 2,000 to 2,102 feet, were above land surface. During July and August 1979, water levels ranged from about 8 to 13 feet above land surface. Chloride concentrations of water sampled through the drill stem from a depth of 632 to 2,039 feet ranged from 25 to 710 milligrams per liter. Chloride increased markedly below 2,039 feet to a maximum of 7,800 milligrams per liter at 2,094 feet. After completion of the well, chloride was 8,100 milligrams per liter. (USGS)
W81-00151

HYDROLOGIC MONITORING PROGRAM IN ELDRIDGE-WILDE AND EAST LAKE ROAD WELL-FIELD AREAS, PINELLAS AND HILLSBOROUGH COUNTIES, FLORIDA, 1977 WATER YEAR,
Geological Survey, Tallahassee, FL. Water Resources Div.
B. F. Joyner, and J. M. Gerhart.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver CO 80225, paper copy, $5.00, microfiche $3.50. Geological Survey Open-File Report 80-345, 1980. 34 p, 20 Fig, 4 Tab, 13 Ref.

Descriptors: *Observation wells, *Monitoring, *Water levels, *Water quality, *Florida, Groundwater, Aquifers, Saline water-freshwater interface, Saline water intrusion, Rainfall, Pumping, Drawdown, Water table, Potentiometric level, Hydrologic data, *Floridan aquifer, Pinellas County(FL), Hillsborough County(FL), Well fields.

The observation-well network in the vicinity of the two well fields is described in detail. Data obtained from the network from October 1976 through September 1977, as well as rainfall and pumpage records, are presented and discussed. Below-normal rainfall caused the water table and potentiometric surface of the Floridan aquifer in Eldridge-Wilde well field to recover 2 feet less in September 1977 than in the previous September. Water levels in East Lake Road will field were approximately the same in Spetember of both years. The Southwest Florida Water Management District has established regulatory water-level and water-quality

limits in several observation wells. Water levels did not drop below regulatory limits during the year. Water from two deep wells west of Eldridge-Wilde well field exceeded the regulatory limits for chloride concentrations. The position of the 250 milligram per liter chloride line is shown in cross section in the vicinity of Eldridge-Wilde well field in September 1977. Network modifications are proposed that would result in a more comprehensive knowledge of the hydrologic system. (USGS)
W81-00153

GROUND-WATER DATA FOR BILLINGS, GOLDEN VALLEY AND SLOPE COUNTIES, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
L. O. Anna.
North Dakota County Ground-Water Studies 29--Part II, and North Dakota Geological Survey Bulletin 76--Part II, 1980. 241 p, 2 Fig, 1 Plate, 9 Tab, 25 Ref.

Descriptors: *Groundwater, *Basic data collections, *North Dakota, *Aquifer characteristics, *Water quality, Water supply, Groundwater availability, Hydrogeology, Water wells, Groundwater recharge, Well data, Water yield, Potential water supply, Observation wells, Water levels, Water users, Chemical analysis, Billings County(ND), Golden Valley County(ND), Slope County(ND).

The purpose of the investigation in Billings, Golden Valley, and Slope Counties, ND., was to determine the availability and quality of ground water for municipal, domestic, industrial, and irrigation uses. Specifically, the objectives were to: (1) determine the location, extent, and nature of the major aquifers and confining beds; (2) evaluate the occurrence and movement of ground water, including the sources of recharge and discharge; (3) estimate the quantities of water stored in the aquifers; (4) estimate the potential yields of wells tapping the major aquifers; (5) determine the chemical quality of the ground water; and (6) estimate the water use. The data in this report were collected between 1974 and 1977. The data consist of the following; (1) Geologic and hydrologic records for 723 wells, test holes, springs, and miscellaneous data-collection sites; (2) water-level measurements in 48 observation wells; (3) lithologic and geophysical logs of 367 test holes and wells; (4) 273 chemical analyses of ground water; (5) 33 chemical analyses of surface water during low flow; (6) 18 chemical analyses of ground water for trace constituents; (7)9 chemical analyses of ground water for dissolved gases; (8) 62 analyses of core samples for hydraulic parameters and particle-size distribution; and (9) 29 analyses of core samples for heavy mineral content. (USGS)
W81-00158

GROUND-WATER RESOURCES OF DICKEY AND LA MOURE COUNTIES, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
C. A. Armstrong.
North Dakota County Ground-Water Studies 28--Part III, and North Dakota Geological Survey Bulletin 70-Part III, 1980. 61 p, 18 Fig, 2 Plates, 3 Tab, 47 Ref.

Descriptors: *Groundwater resources, *North Dakota, *Aquifer characteristics, *Water yield, *Water quality, Water supply, Chemical properties, Groundwater availability, Hydrogeology, Water wells, Data collections, Water level fluctuations, Groundwater recharge, Transmissivity, Maps, Hydrographs, Water utilization, Dickey County(ND), LaMoure County(ND).

Ground water in Dickey and LaMoure Counties, ND., is obtained from Glacialdrift aquifers of Quaternary age, the Pierre, Newcastle, and Lakota-Fall River aquifers of Cretaceous age, and the Black Island aquifer of Ordovician age. The major glacial-drift aquifers, at depths of 0 to 304 feet, will yield as much as 1,500 gallons per minute of water containing 248 to 1,890 milligrams per liter dissolved solids. The Pierre aquifer generally yields less than 5 gallons per minute to wells. The water contains from 1,400 to 8,630 milligrams per liter dissolved solids. The Newcastle aquifer system, is at depths ranging from 790 to somewhat more than 2,000 feet, and is separated into two aquifers. Well yields generally are less than 80 gallons per minute. Dissolved-solids concentrations range from 2,060 to 4,590 milligrams per liter. The Lakota-Fall River aquifer, at depths of 1,100 to 2,200 feet, locally should yield as much as 1,000 gallons per minute. Dissolved-solids concentrations range from 2,030 to 4,850 milligrams per liter. The Black Island aquifer, at depths from 1,421 to 3,000 feet, contains water that has 2,520 and 3,800 milligrams per liter dissolved solids. (USGS)
W81-00159

DESIGN IS THE KEY TO A GOOD RECHARGE WELL,
UOP, Inc., St. Paul, MN. Johnson Div.
A. J. Smith.
Public Works, Vol 111, No 10, p 66-67, October, 1980. 2 Fig.

Descriptors: *Artificial recharge, *Recharge wells, *Design, *Injection wells, *Injection, Induced infiltration, Pore water, Well screens, Thermal properties, Head loss, Groundwater recharge.

A recharge well located near Grand Island, Nebraska is described which was pumped continuously at a rate of 750 gpm for 6 months. The use of injection water which was nearly sand free is credited with the long-lasting period of pumping. Designing a sand-free well requires sizing of the screen slot in accord with established standards of natural development or gravel packing. The well must be able to recharge at a rate equal to the production rate. The screen must also take full advantage of the aquifer characteristics. The diameter of the well is an important factor which is often determined by the size of the pump selected to be installed. Accurate placement of the screen in the permeable zones is a vital step in design of the well. In injection wells it is often recommended that large parts of the aquifer be screened as opposed to only the most productive parts. Problems such as plugging due to air entrainment, precipitates, and bacteria and thermal interference are discussed. (Baker-FRC)
W81-00243

4C. Effects On Water Of Man's Non-Water Activities

HYDROLOGICAL AND ENVIRONMENTAL CONTROLS ON WATER MANAGEMENT IN SEMIARID URBAN AREAS,
Arizona Water Resources Research Center, Tucson.
S. Resnick, and K. J. DeCook.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-109704, Price codes: A05 in paper copy, A01 in microfiche. Project Completion Report, September, 1980. 70 p, 14 Fig, 19 Tab, 7 Ref, Append. OWRT B-012-ARIZ (6), 14-31-0001-3056.

Descriptors: Urbanization, Water management(Applied), Water reuse, *Urban runoff, *Semiarid climates, *Water pollution sources, *Water treatment, *Rainfall-runoff relationships, Small watersheds, Arizona.

Rainfall and runoff studies initiated in 1968 by the University of Arizona provide data for three small urban watersheds with different land use patterns in Tucson, AZ. Annual precipitation of about 11 inches produces annual runoff, as measured at outflow flumes, ranging from 1.30 to 3.95 inches, produced by 15 to 23 runoff events per year. About 60 to 70% of the annual runoff events occur in the summer season, as does 65 to 75% of the annual volume of measured runoff. Water samples collected on a lumped basis show generally high concentrations of suspended sediment, bacterial loading, and dissolved organics. Initial field treatment and exploratory laboratory studies of treatment methods indicate that three days is an optimal length of time for detention storage of runoff, reducing average pollutant concentrations to 62 mg/l of turbidity, total coliform of 70-3200 organisms per 100 mg/l, and 7 mg/l of chemical oxygen demand. Simple laboratory treatment with alum and polyelectrolyte yielded an 80% reduction in COD, 90% reduction in bacterial loading, and appreciable clarification of the runoff samples. Continuing research should be conducted to utilize a longer data record for improving understanding of rainfall-runoff relations; to use distributed sampling within individual watershed areas to define specific pollutant source areas; and to incorporate economic and legal questions involved in the utilization of urban runoff in an arid area.
W81-00006

EFFECTS OF URBAN RUNOFF AND WASTEWATER EFFLUENT ON WILSONS CREEK AND JAMES RIVER NEAR SPRINGFIELD, MISSOURI,
Geological Survey, Rolla, MO. Water Resources Div.
W. R. Berkas.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-201775, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-27, March 1980. 31 p, 15 Fig, 4 Tab, 10 Ref.

Descriptors: *Water pollution effects, *Urban runoff, *Municipal wastes, *Water quality, *Missouri, Effluents, Water pollution sources, Streamflow, Rainfall, Storm runoff, Flood frequency, Hydrologic data, *Wilsons Creek(MO), *James River(MO), *Springfield(MO).

Statistical analysis on water-quality parameters from James River upstream and downstream from the confluence of Wilsons Creek shows a significant difference for all parameters except temperature and dissolved silica at the 0.05 probability level. Regression analysis shows correlation for discharge with dissolved sodium, dissolved chloride, and dissolved potassium, and for specific conductance with dissolved chloride and dissolved sulfate at the station downstream from Wilsons Creek. This is due to the consistent quality of the effluent from the Southwest Wastewater Plant on Wilsons Creek. Water-quality monitor stations upstream and downstream from the wastewater plant indicate that the plant has a degrading effect on dissolved oxygen in Wilsons Creek and James River. The monitors also indicate that rainfall flushes momentarily poor quality water into Wilsons Creek from the urbanized Springfield area. Overall, the runoff is diluting the effluent from the wastewater plant. Rainfall and runoff stations indicate a rapid response of runoff to rainfall due to the high percentage of imperviousness and the filling or paving of sinkholes. (USGS)
W81-00065

THE INFLUENCE OF URBANIZATION ON THE AQUEOUS TRANSPORT AND DISTRIBUTION OF HEAVY METALS IN THE SADDLE RIVER,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 5B.
W81-00099

THE MANGROVE SWAMP - AN ECOSYSTEM IN DANGER,
Swedish Water and Air Pollution Research Lab., Stockholm.
O. Linden, and A. Jernelov.
Ambio, Vol 9, No 2, p 81-88, 1980. 7 Fig, 42 Ref.

Descriptors: *Mangrove swamps, *Land forming, *Erosion control, *Coasts, *Soil stabilization, Flood control, Vegetation establishment, Marine animals, Life cycles, Ecology, Ecosystems, Tropical regions, Water pollution effects, Thermal pollution, Herbicides, Land reclamation, Land development.

Coastal mangrove swamp ecosystems are becoming threatened by pollution and land reclamation. Mangrove swamps exist in tropical areas with high

year-round precipitation usually between the high and low tide marks and often form the boundary between oceans and tropical forests. Mangrove environs are characterized by a thick layer of very loose organic soil which is anaerobic just below the sediment surface; this soil is partly formed by the detritus of the mangroves and silt that is washed in and held by the mangrove swamps. The accumulation of sediments and detritus and the growth of widespread root systems to accommodate the loose, anaerobic soil contribute to rapid land formation by mangrove swamps and also provide significant erosion protection. Various flora and fauna ecosystems are associated with mangrove swamps and some organisms are dependent upon mangroves for shelter as well as food during larval and juvenile stages of development. Mangroves are highly susceptible to herbicides and thermal pollution and grow in areas frequently exposed to oil contamination. The mangrove swamps are also impacted by land reclamation activities and by harvesting; these activities have led to flooding and the destruction of other forms of vegetation. (Lisk-FRC)
W81-00206

UNDERGROUND DERELICTION IN THE NORTH WEST,
J. G. Lloyd.
Water Services Vol 8, No 1014, p 519-520, 523-524, 527, August, 1980. 4 Fig.

Descriptors: *Underground structures, *Urbanization, *Water resources development, *History, *Water districts, Sewers, Sewerage, Water pollution, Industrial wastes, Storm drains, Local governments, Costs, Overflow, Repairing, Construction, Collapse.

The development of sewage drainage systems and water supplies in the industrial northwest of England (including the cities of Liverpool and Manchester) is described. With the rapid industrialization of the first half of the 19th century, wells, springs and rivers rapidly became polluted from overloaded and piecemeal drainage systems. By the 1840s, major contributions were looking beyond their boundaries for unpolluted water, and by 1850 a series of catchment reservoirs was established in the Pennine hills. However, until 1974, 58 separate local authorities managed the sewers and sewage disposal in the area of Greater Manchester County. Since then, water supplies have been managed on a regional basis. In the early 1800s, various types of design and construction were used to build the surface water sewers, and most of these early sewers were built of poor quality soft bricks. Many sewers and old water mains need to be replaced on a large scale due to unsatisfactory forms of construction, decrepit structural condition, inadequate carrying capacity, and inappropriate location. Flooding by sewage in streets and homes, underground decay causing sewer collapses, and the proliferation of storm sewage overflows from sewerage system to watercourses, point to the need for restructuring and repairing existing systems rather than simply repairing collapses. Financial assistance from the national government will be necessary to repair underground dereliction while at the same time further developing water resources and reducing pollution. (Baker-FRC)
W81-00233

4D. Watershed Protection

SEDIMENT-TRAP EFFICIENCY OF A MULTIPLE-PURPOSE IMPOUNDMENT, NORTH BRANCH ROCK CREEK BASIN, MONTGOMERY COUNTY, MARYLAND, 1968-76,
Geological Survey, Harrisburg, PA. Water Resources Div.
W. J. Herb.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $2.50. Geological Survey Water-Supply Paper 2071, 1980. 41 p, 19 Fig, 11 Tab, 19 Ref.

Descriptors: *Sediment control, *Trap efficiency, *Storm runoff, *Multiple-purpose reservoirs, *Maryland, Small watersheds, Urbanization, Land use, Stream flow, Flo characteristics, Suspended load, Bed load, Sediment transport, Sediment yield, Particle size, *Noth Branch Rock Creek basin(MD), *Montgomery County(MD).

Lake Bernard Frank, a multiple-purpose reservoir in Montgomery County, Md., impounds runoff and sediment from 12.5 square miles of the upper North Branch Rock Creek basin. A U.S. Geological Survey study between 1967 and 1976 measured a sediment-trap efficiency of 96 percent for the impoundment. The impoundment's capacity-inflow ratio of 0.37 indicates a theoretical trap efficiency of 95 percent. Suspended-sediment outflow from the impoundment was measured as 5,910 tons for the 1968-76 water years. A total sediment inflow of 136,000 tons was estimated for the same priod. The inflow estimate was based on measured inflow, inflow computed from daily sediment-transport curves, inflow computed from land-use/land-cover sediment-yield relationships, and empirical bedload equations. Discharge-weighted percentages of sand, silt, and clay averaged 16, 50, and 34 percent upstream from the impoundment and were zero, 16, and 84 percent below the reservoir. Average streamflow conditions and recent sediment yields indicate the total sediment-pool capacity will be filled in 27 more years, or by the year 2003. (USGS)
W81-00060

DEVELOP WATER MANAGEMENT METHODS FOR WATERSHEDS SUBJECT TO INTENSIVE DEVELOPMENT,
Arizona Univ., Tucson. Water Resources Research Center.
J. Ben-Asher, M. Diskin, U. Kafri, S. D. Resnick, and M. Sneidovich.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-113318, Price codes: A03 in paper copy, A01 in microfiche. Partial Project Completion Report, September, 1980. 28 p, 6 Fig, 8 Tab, 13 Ref. OWRT-A-069-ARIZ(4), 14-34-0001-6003.

Descriptors: *Model studies, *Hydrologic budget, Water balance, *Equations, *Watersheds(Basins), *Water management(Applied), Hydrology, Hydrologic systems, Hydrologic properties, Mathematical studies, Rational formula, Groundwater basins, Groundwater, Water quality, Chemical analysis, Evapotranspiration, Basins, Runoff, Lakes, Mathematical models, Engineering, Hydrologic aspects.

Assessment was made that a model of the hydrologic system is the only possible link between the hydrologist and the systems engineer in dealing with water management methods for watersheds potentially subject to intensive future development, as exemplified by the Sonoita Creek Basin in Arizona. The water balance picture taken by the hydrologist must be advanced to where the response will be known of the considered aquifer to different water policies. From this point, integration of the environment with its management can be properly addressed. An appropriate model is the overall goal of a hydrologists' study, since it will enable him to simulate relationships between recharge, discharge, and groundwater elevation. Hence, a water balance model was calibrated, and a working routine was developed with the model that was used by the systems engineers. Water balance equations consider Basin precipitation, groundwater underflow into the Basin, Basin evapotranspiration, evapotranspiration from the lake and vegetation strip, groundwater outflow from the Basin, groundwater inflow into the lake and vegetation strip, groundwater recharge, runoff, and change in soil and groundwater storage. Groundwater quality was determined by standard chemical analysis (plus iron, copper, zinc, and lead) on well water samples. (Zielinski-IPA)
W81-00115

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

SEPTIC TANK DRAINFIELD FAILURES RESULTING FROM MINERALOGICAL CHANGES,
Virginia Polytechnic Inst. and State Univ., Blacksburg, VA. Dept. of Agronomy.
L. W. Zelazny, D. A. Lietzke, and H. L. Barwood.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-114662, Price codes: A07 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Virginia Polytechnic Institute and State University Bulletin 124, September 1980, 118 p, 71 Fig, 19 Tab, 36 Ref. OWRT A-079-VA(1).

Descriptors: *Septic tank drainfield failures, *Mineralogical changes, *Soils, *Groundwater, Water pollution, Wastewater, Waste disposal, Sewage, Chemical analysis, Cation exchange, Water analysis, Soil analysis, Analytical techniques, *X-ray diffraction.

The purpose of this study was to determine whether septic tank drainfield failures in areas containing soils with a high biotite or chloritized vermiculite component could be the result of mineralogical changes that decrease the permeability of the soil at the drainfield interface. Twenty-four drainfields in 5 Virginia counties were examined. Soil samples were taken at 16 sites and examined in the laboratory for chemical and mineralogical changes. Visible alterations were detected at the soil-drainfield interface, and all systems examined showed some chemical change. X-ray diffraction analysis revealed a mineralogical change in 12 sites, with 6 of these sites showing distinct change, consisting primarily of the conversion of vermiculite chlorite intergrade into vermiculite and sometimes some montmorillonite, with some dissolution of kaolinite. Soil samples from sites with significant vermiculite chlorite intergrade content showed an increase in the sum of exchangeable bases at the soil-drainfield interface, apparently linked to interlayer removal and vermiculite formation. The exchange complex of the soil at the drainfield interface was selective for calcium and sometimes magnesium and was not dominated with sodium, which was high in the effluent. Samples from some sites did show an increase in organic matter at the interface. However, the increase was not considered sufficient to cause a reduction of flow in the drainfield. Field examinations of the soils revealed that the primary mode of effluent movement was channelized flow. At no site did the drainfield fail for purely mineralogical reasons. However, the changes detected could contribute to the eventual failure of the system by decreasing soil permeability, especially in soils with initial low permeability.
W81-00004

DEVELOPMENT AND EVALUATION OF ELECTROANALYTICAL METHODS FOR DETERMINATION OF METAL-ION CONCENTRATIONS IN WATER,
West Virginia Univ., Morgantown. Water Research Inst.
J. H. Strohl, B. Bezilla, R. Romanosky, and J. T. Maloy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-110736, Price codes: A02 in paper copy, A01 in microfiche. Technical Completion Report 1980. 18 p, 4 Fig, 2 Ref. OWRT-A-035-WVA (1), 14-34-0001-0852.

Descriptors: Analysis, Analytical techniques, *Electrochemistry, *Methodology, *Trace elements, *Water analysis, Anodes, Chemical analysis, Electrodes, Electrolysis, Evaluation, Metals, Mine water, Water pollution, Water quality, Silver, Copper, Cadmium, Zinc.

This study was directed toward the development of electrochemical procedures that would be suitable for the on-site determination of the concentra-

tions of some metal ions and halide ions. The methodology was based on semi-integral analysis for the qualitative identification and on stripping analysis for the quantitative determination of metal ions. Of the three electrode systems developed as a part of this project, two systems were found to be suitable for portable use. The overall system was found to be capable of determining silver, copper, cadmium, and zinc (Ag(+), Cu(2+), Cd(2+), and Zn(2+)) concentrations as low as 0.08 parts per million (ppm), chloride as low as 0.35 ppm, and ferrous iron (Fe(2+)) and ferric iron (Fe3+)) at the 0.3 ppm level.
W81-00013

PRODUCTIVITY OF GREAT LAKES ZOOPLANKTON,
Ohio State Univ., Columbus. Dept. of Zoology.
D. A. Culver.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-109829, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center, Ohio State University Project Completion Report No 710799-760851, May 1980, 60 p, 14 Fig, 8 Tab, 30 Ref, 3 Append. OWRT-A-048-OHIO (1).

Descriptors: *Great Lakes, *Zooplankton, *Productivity, Cladocera, Copepoda, Rotifera, Lake Erie, Lake Ontario, Toxicity, Non-ionic detergents, Forecasting, Growth rates, *Mathematical models.

A mathematical model of zooplankton productivity for the Laurentian Great Lakes has enabled us to calculate productivity rates for Cladocera, Copepoda, and Rotifera from Lakes Ontario and Erie. Productivity values from the Bay of Quinte, Lake Ontario, demonstrated that nearshore productivity and biomass varied greatly along with algal abundance and temperature. A study of 30 stations in Lake Erie on 10 monthly cruises showed that total productivity of the zooplankton community is strongly correlated with temperature, but that individual taxa varied significantly throughout the season. Productivity in the open water of Lake Erie (1970) was much less than the values observed in the Lake Erie and Lake Ontario nearshore zones. Comparison of the roles of Copepoda, Cladocera, and Rotifera in the over-all productivity showed that Copepoda predominated in the spring, along with rotifers, but that Cladocera were the most important producers during the summer. Measurements of cladoceran size at first reproduction showed that they reach maturity at a large size in the spring and decline in size at maturity through the summer, with all species declining in size in a synchronous pattern. It is suggested that this pattern results from the combined effects of size-selective predation by fish and competition among cladocerans for food.
W81-00017

DEVELOPMENT OF A SIMPLE MEANS FOR PREDICTING ALGAL BLOOMS,
Syracuse Univ., NY. Dept. of Civil Engineering.
S. Litten, S. W. Effler, and M. Meyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-112625, Price codes: A04 in paper copy. Technical Completion Report, September 1980. 53 p, 22 Fig, 16 Tab, 19 Ref. OWRT-B-087-NY (1), 14-34-0001-9086.

Descriptors: *Algae, *Algal control, Algicides, Biomass, Algal blooms, Color, Copper sulfate, *Lakes, Reservoirs, Phytoplankton, Chlorophyll, Indicators, Predicting algal blooms, New York, Syracuse area(NY).

A simple technique to predict the future occurrence of algal blooms was evaluated for seven test lake systems proximate to Syracuse, NY during the summer of 1978 and 1979. The selected test systems represent a broad range of trophic status, from mesotrophic to hypereutrophic. The technique includes a simple filtering process followed by the identification of the color imparted to the filter, based on comparison to National Bureau of Standards' color chips. The reference measure of phytoplankton standing crop was chlorophyll-a. Particular colors of filtered particulates were not demonstrated to be useful estimators of chlorophyll-a concentration, though the hues olive and yellow- green were associated with higher chlorophyll-a levels. In several of the lakes particulate lightness and color saturation were significant estimators of chlorophyll-a. In addition, the particulate color method was demonstrated to be useful in following certain physical/chemical changes in a lake.
W81-00018

TESTS OF TWO FLUOROMETRIC ASSAYS FOR GONYAULAX AND APHANIZOMENON TOXINS,
New Hampshire Univ., Durham. Dept. of Biochemistry.
P. W. Carter.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-112740, Price codes: A04 in paper copy. Master of Science Thesis, 1980. 43 p, 14 Fig, 3 Tab, 36 Ref. OWRT-A-047-NH (4), 14-34-0001-8031.

Descriptors: *Bioassay, *Assay, *Shellfish, *Toxins, *Red tides, Analytical techniques, Fluorometer, Dinoflagellates, Poisons, Blue-green algae, Algae blooms, *Solution fluorometric assay, Paralytic shellfish poisoning, Algae extracts, Column fluorometric assay, Aphanizomenon flos-aquae, Column chromatography, Spectrofluorometer, Food poisoning.

The purpose of this research was to further test two assay procedures with shellfish extracts and with A. flos-aquae cells: a solution fluorometric assay and a column chromatography assay using Dowex AG-50W-X4, a sulfonic acid cation exchange resin, both developed by Shoptaugh. The assays were also tested to see if an inexpensive filter fluorometer could be used instead of the spectrofluorometer used in developing the assays. Attempts were also made to clean up the shellfish extracts by column chromatography in order to improve the sensitivity of the assay when used with the filter fluorometer. The research demonstrated that the solution fluorometric assay for PSP in shellfish gives results which are comparable to the mouse assay for shellfish of high toxicity and which are possibly more accurate than the mouse assay for shellfish of low toxicity. The assay, therefore, merits consideration for the routine monitoring of toxicity of shellfish. It was also shown that the assay was ineffective when a less expensive filter fluorometer was used in place of a spectrofluorometer. Attempts to modify the assay for use with a filter fluorometer were unsuccessful, but the problems encountered with the chromatographic clean-up of the extracts do not seem to be insurmountable. It is likely, therefore, that the assay could be adapted for use with a filter fluorometer. The column fluorometric assay appeared to be inapplicable to shellfish extracts, a finding which contradicts Shoptaugh's data. However, this assay did appear to be of some use when applied to extracts of the blue-green alga Aphanizomenon flos-aquae.
W81-00020

EFFECTS OF A HEPATIC TOXIN FROM THE CYANOPHYTE, MICROCYSTIS AERUGINOSA,
New Hampshire Univ., Durham. Dept. of Zoology.
T. L. Foxall.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-112708, Price codes: A06 in paper copy. Ph.D. Thesis, 1980. 107 p, 17 Fig, 2 Tab, 55 Ref, 1 Append. OWRT-A-047-NH (3), 14-34-0001-8031.

Descriptors: *Toxins, *Cyanophyta, *Blue-green algae, Poisins, Microorganisms, *Eutrophication, Lakes, Ponds, Evironmental effects, Ecosystems, *Hepatic toxin, *Microcystis aeruginosa, *Cyanobacteria, *Microcystin, Freshwater blooms, Liver damage, Blooms.

Toxic cyanobacteria bloom in eutrophic, freshwater lakes and ponds and may cause environmental, health and recreational problems during or after the massive growth of these microorganisms. Microcystis aeruginosa is commonly involved in freshwater blooms and one of its toxins (microcystin) causes liver damage in birds and mammals. This sutdy has determined the specific site of action of microcystin and characterized the hepatic damage at the ultrastructural level. Histological changes in centrilobular regions of liver tissure were noted after intraperitoneal administration in mice. Hepatic sinusoidal epithelial and hepatocyte plasma membranes ruptured with the release of cellular components that pooled with blood. Mitochondria appeared swollen but there were no obvious distortions of other organelles. Extensive vesiculation of membrane fragments was observed. Hepatic damage caused massive hemorrhaging into the liver where blood and cell debris accumulated and produced a significant increase in liver weight. Primary cultures of hepatocyte microexplants from pre- and postnatal mice and rats were exposed to microcystin but in vitro effects were not observed. In vitro experiments showed that young animals were not sensitive to the toxin but developed sensitifity as they matured. Microcystin was shown to be very specific in its site of action since it had no antiplanktors, crustacea, amphibians and teleosts. Electrical or mechanical activity in isolated nerve, nerve-muscle and cardiac preparations also was not effected. Toxins came from cultured cells and naturally occurring blooms and gave identical results in all experiments.
W81-00026

A TRIHALOMETHANE STUDY OF THE DURHAM, NEW HAMPSHIRE WATER TREATMENT PLANT,
New Hampshire Univ., Durham. Dept. of Civil Engineering.
K. M. Stewart.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-110363, Price codes: A04 in paper copy, A01 in microfiche. Master of Science, 1978. 62 p, 5 Fig, 8 Tab, 14 Ref, 3 Append. Plan 'B' Paper. OWRT-A-048-NH (1), 14-34-0001-8031.

Descriptors: *Water treatment, *Chemical analysis, *Organic compounds, *Chlorination, New Hampshire, Separation techniques, Finished water, Raw water, *Trihalomethane, *Chloroform, *Bromodichloromethane, Liquid-liquid extraction, Synthetic organic chemicals, Carcinogens, Durham(NH).

This study quantified the levels of chloroform and bromodichloromethane in the finished water from the water treatment plant in Durham, New Hampshire and investigated the effects of temperature, contact time, and point of chlorination on the levels of these compounds found in the finished water. Finished water samples were collected during April 1978, stored under controlled conditions and analyzed for trihalomethanes by gas chromatography utilizing the liquid-liquid extraction technique. Test results indicated that while the raw water contained no detectable trihalomethanes, chloroform was present in the finished water in concentrations ranging from 9 mg/1 to 170 mg/1 depending upon storage temperature, contact time, and point of chlorination. Bromodichloromethane was also present in the finished water but at very low concentrations (2 - 10 mg/1). Dibromochloromethane and bromoform were not detected. Reductions of average total trihalomethane concentrations as high as 27% were achieved by simply changing the point of chlorination from raw water to settled water.
W81-00033

RAPID DETERMINATION OF BACTERIAL WATER QUALITY THROUGH IMPROVED COLIFORM TEST PROCEDURES,
Northern Arizona Univ., Flagstaff. Dept. of Microbiology.
H. K. Speidel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-113060, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, September 1980. 10 p. OWRT-A-093-ARIZ(1), 14-34-0001-9003.

Group 5A—Identification Of Pollutants

Descriptors: *Coliforms, *Water analysis, *Analytical techniques, *Testing procedures, Water quality, Aquatic bacteria, Microbiology, Sewage bacteria, Microorganisms, E. coli, Gas chromatography, Alcohols, Testing, Laboratory tests, Quality control, Membranes, Filtration.

Several innovative methods were investigated as potential rapid methods for the determination of coliform bacteria in domestic water. A literature survey and laboratory experiments were conducted to critically evaluate the limitations of current membrane filtration methodology for the determination of total coliform bacteria. Several approaches were made to develop media with improved selection/differentiation properties. Tergitol agar, not recommended for recreational water analysis, may be useful for potable water evaluations due to its desirable recovery characteristics. Bromthymol blue produced detectable coloration of colonies grown in six hours of incubation, but low reliability of differentiation between coliform and non-coliform colonies was observed. Finally, a gas chromatographic analysis method was examined, based on the determination of ethanol from ethanol-producing coliform bacteria in water. The method was found to be applicable to the determination of ethanol-producing coliform bacterial concentrations ranging from 2-2000 organisms per 100 ml of water within 12 hours of culture incubation. While the methods studied are not sufficient to substitute for conventional coliform assays, further work and refinement of innovative approaches was encouraged in order that a more rapid determination of bacterial water quality might be attained. (Zielinski-IPA)
W81-00075

CHANGES IN PHOSPHORUS CONCENTRATIONS DUE TO MIXING BY MOTORBOATS IN SHALLOW LAKES,
University of Central Florida, Orlando. Engineering and Industrial Experiment Station.
For primary bibliographic entry see Field 2H.
W81-00100

RAPID ANALYSIS OF ORGANIC POLLUTANTS IN SURFACE WATERS BY HIGH-PRESSURE LIQUID CHROMATOGRAPHY,
Wisconsin Univ.-Madison. Water Resources Center.
K. Huibregtse, and J. M. Harkin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-116881, Price codes: A03 in paper copy, A01 in microfiche. Technical Report WIS WRC 80-08, 1980. 32 p, 16 Tab, 9 Ref. OWRT-A-069-WIS(2), 14-34-0001-6052, 14-34-0001-7105, 14-34-0001-7106.

Descriptors: Pollutants, *Organic compounds, *Chromatography, Analytical techniques, *Water analysis, Water pollution sources, *Surface waters, Analysis, *Pollutant identification, Chemistry, Evaluation, Estimating, Instrumentation, Research and development, Testing, Testing procedures, Chemical analysis, Graphical analysis, Water pollution, Assay, Sampling, Water sampling, Correlation analysis.

A procedure was developed for the concentration and separation of nonpolar organic compounds from water samples using reversed-phase high-pressure liquid chromotography (HPLC) with trace enrichment. Using this procedure, a filtered water sample (30-1000 ml) was passed through an HPLC precolumn containing Porasil C-18, which was then coupled to a high-efficiency micro-Bondapak C-18 analytical column for HPLC separation and fingerprinting of the concentrated aqueous organics. An alternate method, used for fingerprinting of organics associated with suspended sediments, used a vacuum aspirator to pass unfiltered river bottom water samples through a teflon Poracil C-18 cartridge containing end filters, with dissolved organics concentrated on the C-18 and particulate/colloidal-bound organics on the filters. HPLC fingerprints were obtained on samples collected from various waterways, and fingerprint comparisons were made by determining the percentage of peaks present in one chromatogram that were also present in another. A high percent similarity indicated little change occurred in river flow quality between two sample collection points; a low percent similarity indicated major changes in waterway organics, suggesting influx of contaminants from a point source. Analysis of river bottom sediment samples was recommended over conventional water samples to locate the source of a large hazardous chemical spill. (Zielinski-IPA)
W81-00108

SOURCES AND BEHAVIOR OF NATURAL RADIOACTIVITY IN FALL LINE AQUIFERS NEAR LEESVILLE, SOUTH CAROLINA,
South Carolina Univ., Columbia.
J. Michel, and W. Moore.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-116840, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute, Clemson University, Clemson, South Carolina. Technical Report No 83, Februar, 1980. 73 p, 17 Fig, 11 Tab, 46 Ref. OWWR-B-116-SC(1), 14-34-0001-8115.

Descriptors: *Radium radioisotopes, *Radioactivity, *Isotope studies, *Water pollution sources, *Aquifers, *Groundwater, Water pollution treatment, Radioisotopes, Radiochemical analysis, Soil contamination, Radioactive wastes, South Carolina, Background radiation, Groundwater reservoirs, Water quality, Water management(Applied), Groundwater management, Potable water, Environmental control, Radioactivity effects, Water quality standards.

This project sought to determine the sources, behavior and controls of the radioactive Ra-226 and Ra-228 content of groundwater along the Fall Line of South Carolina; to understand the mechanisms for groundwater acquisition of radium; and to identify the sources and mode of occurrence of the uranium and thorium materials in the aquifer sediments. Groundwater from the Coastal Plain aquifers along the Fall Line near Leesville, South Carolina, had unexpectedly high radium activities, with Ra-228 an important part of the total, a Ra-226 content varying from 3.5-23.0 pCi/liter a radium 228/226 activity ratio among Leesville city wells from 0.23-3.0 (constant for a single well over time), and a total radium content of these wells from 10.8-29.7 pCi/liter. The high Ra-228 may affect the EPA interim drinking water standards for radium. Manganese-impregnated fibers can be used for technically/economically feasible treatment for radium isotopes removal. High Rm-222 was observed, 250-7750 pCi/liter, in Piedmont rock well groundwaters, suggesting a potential health hazard from high radon by out-gassing at the faucet. It is concluded that, while sufficient groundwater exists for doubling the present groundwater use by Leesville, groundwater treatment must be exercised for radium removal or dilution. (Zielinski-IPA)
W81-00113

MODELING OF HEATED SURFACE JETS,
State Univ. of New York at Buffalo. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 5B.
W81-00114

A RE-EVALUATION OF LEAD-210 CHRONOLOGY AND THE HISTORY OF TOTAL LEAD INFLUX IN A SMALL SOUTH BELGIAN POND,
Liverpool Univ. (England). Dept. of Geography.
F. Oldfield, P. G. Appleby, and D. Petit.
Ambio, Vol 9, No 2, p 97-99, 1980. 4 Fig, 1 Tab, 21 Ref.

Descriptors: *Lead, *Lake sediments, *Dating, *Mathematical models, *Pollutant identification, History, Pollutants, Water pollution, Analytical techniques, Graphical analysis, Bottom sampling, Sampling, Cores, On-site data collection.

Recent sediments from Lake Mirwart, south Belgium were studied along with sediments from other lakes in Northern Ireland, New Guinea, and Finland by stratigraphic and radiometric means to evaluate a model of lead-210 dating at the site. This model is based on the assumption of a constant net rate of supply of unsupported lead-210 to the sediment despite variations in dry mass sedimentation rates within and between cores. Changes in lead concentration and net flux to the sediment from about 1890 AD were calculated by applying the age/depth curves and sedimentation rates derived from the model to stable isotope lead analyses from three Lake Mirwart sediment cores. A dramatic acceleration was found in anthropogenic lead flux during the present century with an especially sharp increase from about 1950 on. These findings were compared with sedimentary and botanical records of lead pollution history from Lake Michigan and southern Scandinavia. It was concluded that lead-210 dating in appropriate situations may provide support for pollution calculations. (Baker-FRC)
W81-00205

SAMPLING PROGRAMME DESIGN FOR WATER QUALITY IN DISTRIBUTION,
Yorkshire Water Authority (England). Office of Scientific Services.
C. S. Short.
Water Services, Vol 84, No 1014, p 529-530, 533-534, 537, August, 1980. 3 Fig, 4 Tab, 1 Ref.

Descriptors: *Water quality, *On-site data collection, *Water analysis, *Sampling, Optimization, Statistical methods, Water distribution(Applied), Management, Methodology, Frequency analysis, Domestic water, Project planning, Potable water, Design.

A procedure for the design of a potable water supply sampling program is proposed, based on identification of management needs and cost-effective use of scientific resources. The program includes statistical analysis of data at the inception of sampling in order to minimize the total amount of samples required and to achieve randomness in the selection of samples. Mathematical treatment of the data includes fitting an appropriate frequency distribution and determining the precision required to meet management-defined objectives. Formulas for computing number of samples and confidence levels are presented. A reporting format for parameters with short-term variations such as turbidity and pH is presented. The procedure was developed in a pilot program. (Titus-FRC)
W81-00232

5B. Sources Of Pollution

HYDROLOGICAL AND ENVIRONMENTAL CONTROLS ON WATER MANAGEMENT IN SEMIARID URBAN AREAS,
Arizona Water Resources Research Center, Tucson.
For primary bibliographic entry see Field 4C.
W81-00006

WATER QUALITY TRANSFORMATIONS AND GROUNDWATER RECHARGE OF SEWAGE EFFLUENT RELEASES IN AN EPHEMERAL STREAM CHANNEL,
Arizona Univ., Tucson. Dept. of Civil Engineering.
S. Ince, R. A. Phillips, and L. G. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-112724, Price code: A02 in paper copy. Project Completion Report, 1980, 20 p, 7 Fig, 5 Tab, 7 Ref. OWRT A-051-ARIZ (2), 14-31-0001-5003.

Descriptors: *Ephemeral streams, *Open channel flow, *Physicochemical properties, *Groundwater recharge, Southwest U.S., Sewage effluents, Path of pollutants, Water quality, Streamflow, Flow rates, Arizona, Santa Cruz River(AZ).

Bio-physicochemical measurements were made on treated sewage effluent releases at established locations within the channel of an ephemeral stream, the Santa Cruz River of Southern Arizona. Water samples were taken in chronological sequence as the effluent moved downstream, to trace changes in quality parameters during low and high hydrograph stages. Results indicate that dissolved

oxygen (DO) concentrations at low effluent flows were higher than DO concentrations at high effluent flows; while, conversely, biochemical oxygen demand (BOD) concentrations at low effluent flows were generally lower than BOD concentrations at high effluent flows. Biochemical oxygen demand concentrations are affected by waste loadings, flow conditions, phytoplankton growth and nitrification. Mean river deoxygenation rates (kr) in sewage flows after six river miles from the Tucson Sewage Treatment Plant were always negative or increasing, indicative of nitrification, algal growth, and concentration of organic constituents through seepage losses.
W81-00019

WATER DISTRIBUTION AND MOVEMENT IN AN UNSATURATED PIEDMONT SOIL PROFILE,
Clemson Univ., SC. Dept. of Agricultural Engineering.
J. T. Ligon, T. V. Wilson, J. F. Allen, T. G. King, and U. P. Singh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-113995, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Institute, Clemson University Report No 82, 1980, 103 p, 44 Fig, 4 Tab, 28 Ref, 3 Append. OWRT-A-023-SC (9).

Descriptors: *Unsaturated flow, *Soil moisture, *Tritum, Radioactive tracers, Percolation, Water table, *Soil water movement, Groundwater recharge, Tracers, Model studies, Seepage, Root zone, Soil types, *Path of pollutants, Piedmont, South Carolina.

The purpose of the study was to further investigate the deep seepage - groundwater recharge phenomenon, to develop models of the deep seepage process and to examine moisture displacement in the profile as it relates to the transport of pollutants from the soil surface downward to the groundwater. The study consisted of field investigations and model development. Field investigations include soil moisture and water table measurements, observations of surface runoff and interflow, and a radioactive tracer study. Two computer programs were written using the IBM simulation language CSMP. In one, called the Root Zone Model, precipitation and temperature data are used to estimate runoff, evapotranspiration and storage in the root zone. Any excess moisture is considered to perculate below the root zone as deep seepage. The second program, called the Deep Seepage model, uses the deep seepage calculated in the Root Zone Model and simulates its movement through the unsaturated zone to the pheatic surface, at a depth of 20m. In general, the Root Zone Model performed well, while the results of the Deep Seepage Model were biased towards an underestimate of the volume of moisture in the profile.
W81-00042

GREAT BLUE HERONS AS ENVIRONMENTAL INDICATORS: ASPECTS OF FORAGING ECOLOGY,
Ohio Cooperative Wildlife Research Unit, Columbus.
G. A. Grau, and R. Parris.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-113979, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center, Ohio State University Project Completion Report No RF 760851-710800, June, 1980. 69 p, 16 Fig, 17 Tab, 51 Ref. OWRT-A-049-OHIO(1).

Descriptors: *Migratory birds, *Animal behavior, *Migration patterns, *Distribution patterns, *Lake Erie, Environmental gradient, Movement, Wading birds, Biorhythms, Migration, Nesting, Wildlife, Birds, Spatial distribution, Temporal distribution, Evaluation, *Great Blue Herons, Environmental indicators, Food chains.

A determination of the amount of seasonal and yearly variation in feeding site locations and the amount of overlap in feeding site locations for herons from the various southwestern Lake Erie region colonies was sought. Ten major feeding locations of Great Blue Herons were determined during this February-August 1977 and March-August 1978 study. Factors affecting heronry stratification, individual heron feeding sites, heron movement behavior, aggressive behavior at the feeding site, and heron populations at sites were included. Flight directions from all colonies were similar since most heron flights were contained within a few flight directions. Flight line patterns for the colonies were relatively constant over the season and between years, suggesting an overall fixed use of feeding areas. Although feeding sites for Sandusky Bay heron colonies overlap, herons of smaller colonies tended to avoid use of marshes around the larger colony. Herons from heronry sections used different flight directions to feeding areas, and flock members leaving the heronry tended to be from the same section; but flock members did not always feed in theme area. Further, the amount of time spent at the feeding sites varied greatly. (Zielinski-IPA)
W81-00044

MICROBIAL TRANSFORMATION OF KEPONE,
Maryland Univ., College Park. Dept. of Microbiology.
S. A. Orndorff, and R. R. Colwell.
Applied and Environmental Microbiology, Vol 39, No 2, p 398-406, February, 1980. 5 Fig, 1 Tab, 25 Ref. OWRT-B-034-MD(1).

Descriptors: *Halogenated pesticides, *Microbial degradation, Chemical analysis, *Marine microorganisms, *Waste water treatment, Pseudomonas, Public health, Organic pesticides, Pesticides, Toxins, Metabolism, Biotransformation, Virginia, Water pollution, Gas Chromatography, Mass spectrometry, Chlorinated hydrocarbons, Microbiology, Water pollution sources, Sewage bacteria, Microorganisms, *Kepone, *James River(VA).

Mixed bacterial cultures and a pure culture of Pseudomonas aeruginosa strain K03 were obtained by enrichment culture of water samples collected from the sludge lagoon at the waste water treatment plant at Hopewell, Virginia, where Kepone production had contaminated the James River to the mouth of the Chesapeake Bay. The K03 strain and an isolated mixed aerobic enrichment culture aerobically transformed the toxic chlorinated pesticide Kepone to monohydro-Kepone (MHK). Verification of the transformation was made by analysis of extracts by gas chromatography with electron capture detection, and gas chromatography coupled to electron-impact mass spectrometry. The K03 strain and the isolated mixed culture also produced about 16% and 4%, respectively, of dihydro-Kepone, as determined by co-chromatography using authentic standards. When compared to the pure and mixed cultures, reduced amounts of MHK were produced by James River sediment microorganisms. Kepone was not useable as a sole source of carbon/energy by any of the bacteria or mixed cultures studied. Kepone concentrations found in Baileys Creek sediment entering the James River was about 1000-2000 parts per million, comparable to that reported by the U.S. Environmental Protection Agency, mostly associated with organic matter and colloidal particles. (Zielinski-IPA)
W81-00048

RESULTS OF WATER QUALITY SAMPLING NEAR RICHTON, CYPRESS CREEK, AND LAMPTON SALT DOMES, MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
L. A. Gandl, and C. A. Spiers.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO. 80225, Paper copy $5.25, Microfiche $5.00. Geological Survey Open-File Report 80-443, 1980. 18 p, 5 Fig, 4 Tab, 8 Ref.

Descriptors: *Water quality, *Sampling, *Surface waters, *Groundwater, *Mississippi, Chemical analysis, Chlorides, Path of pollutants, Hydrogeology, Aquifer characteristics, Radioactive wastes, Underground waste disposal, Evaluation, *Mississippi salt-dome basin, Salt domes.

In the Mississippi salt basin in southern Mississippi, chemical quality studies of surface water and ground water have been made to determine present water-quality conditions near three salt domes being studied by the Department of Energy as potential repositories for radioactive wastes. Chloride concentrations in excess of 60 milligrams per liter in surface water and ground water in Perry County indicate that contamination could be occurring from industrial wastes, oil test wells, or dissolution of Richton or Cypress Creek domes. (USGS)
W81-00053

HYDROLOGY AND WATER QUALITY OF THE LOWER MISSISSIPPI RIVER,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 4A.
W81-00064

EFFECTS OF URBAN RUNOFF AND WASTEWATER EFFLUENT ON WILSONS CREEK AND JAMES RIVER NEAR SPRINGFIELD, MISSOURI,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 4C.
W81-00065

RELATIONSHIPS OF DISSOLVED OXYGEN AND BIOCHEMICAL OXYGEN DEMAND IN SEWAGE EFFLUENT RELEASES,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 4B.
W81-00088

THE EFFECTS ON GROUNDWATER FROM SEEPAGE OF LIVESTOCK MANURE LAGOONS,
Clemson Univ., SC. Dept. of Agricultural Engineering.
R. O. Hegg, T. G. King, and T. V. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-115180, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute, Clemson University Technical Report No 78, September 1979. 47 p, 19 Fig, 3 Tab, 11 Ref, 1 Append. OWRT-B-091-SC(1).

Descriptors: *Groundwater, *Surface-groundwater relationships, *Water pollution, *Livestock, *Farm lagoons, Lagoons, Water quality, Subsurface waters, Dug wells, Groundwater availability, Groundwater resources, Hydrology, Soil water, Underground streams, Water wells, Farm wastes, Test wells, Shallow wells, Water pollution effects.

Three anaerobic swine lagoons in the Southern Coastal Plain of South Carolina were monitored for two years to determine the effects of lagoon seepage on the groundwater. A series of shallow monitoring wells were installed at each lagoon, mostly on the down-gradient side of the lagoon, in a grid pattern. Analyses on well water samples covered temperature, pH, nitrate nitrogen, specific conductance, coliform bacteria, chloride, COD, total organic carbon, ammonia nitrogen, and total kjeldahl nitrogen. Well water table depth, and water consumption were also measured. Most wells showed no discernable trends of changing water quality, but wide variations in the water quality parameters measured were noted. Since most wells were unaffected, non-heterogeneous soil conditions appeared to exist. Subsurface lagoon seepage was impossible to quantitate since only a small number of wells were used, but a water budget compiled for one lagoon indicated an average lagoon leakage rate of 665 liters/day. Lagoon leakage was detected for wells 6 feet from the lagoon, but no groundwater pollution was noted in wells 46 feet away. Use of a larger number of wells was recommended to improve assessment accuracy for subsurface conditions due to soil inhomogeneity. (Zielinski-IPA)
W81-00091

THE INFLUENCE OF URBANIZATION ON THE AQUEOUS TRANSPORT AND DISTRIBUTION OF HEAVY METALS IN THE SADDLE RIVER,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
W. G. Wilber.
Ph.D. Dissertation, May, 1978, 356 p, 59 Fig, 66 Tab, 107 Ref, 3 Append. OWRT-A-050-NJ(2), 14-34-0001-8032.

Descriptors: *Heavy metals, *Water pollution sources, *Sediment distribution, *Path of pollutants, *New Jersey, *Saddle River(NJ), Chemical wastes, Sediment yield, Precipitation, Lead, Copper, Zinc, Stormwater, Urban runoff, Street sweeping.

A study of heavy metals was conducted on a highly developed stretch of the Saddle River near Lodi, New Jersey. The major contributors of heavy metals in stormwater runoff were lead, zinc, and copper. An average of 66 percent of the total suspended solids for three storms studied could be removed after four hours of settling. Unlike the other metals, copper was found predominantly in the soluble plus colloidal fraction of runoff. Relative concentrations of metals in precipitation as compared to those of stormwater were relatively insignificant. Street sweeping samples were also analyzed. Statistical analyses were made relating metals occurrence in water to various related parameters. Concentrations of heavy metals in sediments were variable, but increased passing through the highly developed areas. (Whipple-NJ)
W81-00099

MODIFIED FICKIAN MODEL FOR PREDICTING DISPERSION,
Missouri Univ.-Columbia. Dept. of Civil Engineering.
H. Liu, and A. H. D. Cheng.
Journal of the Hydraulics Division, American Society of Civil Engineers, Vol 106, No HY6, Proceedings Paper 15454, p 1021-1040, June 1980. 8 Fig, 3 Tab, 29 Ref, 2 Append. OWRT-A-103-MO(3).

Descriptors: *Dispersion, *Pollutants, *Path of pollutants, *Model studies, Mathematical models, Water pollution, Rivers, Streams, Flow, Forecasting, Oil spills, Chemicals, Accidents.

The ordinary Fickian model for longitudinal dispersion was modified by using a time or distance dependent dispersion coefficient with a time-scale much greater than the Fischer time scale. From the three bulk flow properties, shear velocity, cross-sectional area, and mean depth of stream, the asymptotic dispersion coefficient, longitudinal dispersion coefficient, and the peak concentration maximum or peak concentration in natural streams can be predicted within a factor of 2.5 and 1.6, respectively. The model is useful for the prediction of longitudinal spread of pollutants in rivers over both short and long distances. (Sims-ISWS)
W81-00104

DIURON LOSS FROM A SMALL WATERSHED IN THE HIGH WINTER RAINFALL ZONE OF WESTERN OREGON,
Oregon State Univ., Corvallis. Dept. of Soil Science.
J. Hickman, M. Montgomery, and M. Harward.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-113334, Price codes: A02 in paper copy, A01 in microfiche. Project Completion Report, September 15, 1980. 10 p, 3 Tab, 4 Ref. OWRT-A-048-ORE(1).

Descriptors: *Herbicides, *Agricultural runoff, Rainfall-runoff relationships, *Small watersheds, Storm runoff, *Mathematical studies, Pesticides, Runoff, Watersheds, Farms, Agricultural watersheds, Agriculture, Crops, Rainfall, Stormflow, Average runoff, Cloudbursts, Direct runoff, Statistical methods, Graphical analysis, Analytical techniques, Gas chromatography, Metabolism, *Path of pollutants.

The herbicide, 3-(3,4-dichlorophenyl)-1)-1,1-dimethyl urea (diuron), was determined in selective runoff samples during storm hydrographs on a 5.1 ha watershed (slopes 3-12%). The watershed was located in southern Polk County about 3 miles south of Monmouth, Oregon. Pre-emergence application of diuron was made at 1.8 kg (active ingredient) per ha to fall-planted winter wheat in late October 1978, about two weeks after planting. Surface runoff from the watershed was measured in a flume, and integrated suspended sediment samples were taken. Following solvent separation of the herbicidally-inactive diuron metabolite, 3,4-dichloroaniline, from the diuron residue, the latter was hydrolyzed to 3,4-dichloroaniline, and its benzene extract analyzed by gas-liquid chromatography with microcoulometric detection. The assay method was sensitive to less than one microgram in a total sample extract. Total diuron loss in the five-month period following application was 0.016 kg/ha, or 0.9% of the total diuron applied. Two major runoffs in early February accounted for 45% of total herbicide loss. A power curve comparing suspended sediment analysis (ppm) against diuron concentration (ppb) was used to calculate total diuron loss from each storm event. The peak herbicide concentration was 80 ppb during the first runoff event, 45 days after application. (Zielinski-IPA)
W81-00109

DEGRADATION OF SELECTED HERBICIDES BY AQUATIC MICROORGANISMS,
Clemson Univ., SC. Dept. of Microbiology.
P. A. Ellis, N. D. Camper, and J. M. Shively.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-113326, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Clemson University. Technical Report 84, February, 1980. 36 p, 11 Fig, 11 Tab, 49 Ref, 2 Append. OWRT-A-041-SC(1), 14-34-0001-9043, 14-34-0001-8043, 14-34-0001-7086.

Descriptors: *Herbicides, *2,6-Dichlobenil, *Metabolism, *Aquatic bacteria, *Biodegradation, *Aquatic fungi, *Pollutant identification, Microorganisms, Aquatic microorganisms, Microbial degradation, Fungi, Ponds, Microbiology, Chromatography, Pollutants, Water pollution, Water pollution sources, Pesticide residues, Analysis, Chemical analysis, Assay, Testing procedures.

Degradation of 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron) herbicide by pond water and pond sediment microorganisms was studied to assess the degradative pathway. An enrichment procedure was used to isolate microorganisms capable of degrading diuron and, while no such isolate could degrade diuron in pure culture, several mixed fungal/bacterial and mixed bacterial isolated cultures could either partially/totally degrade this herbicide. Studies using radiolabeled diuron (C-14 carbonyl group), mixed culture degradation, and analysis by thin-layer chromatography (TLC), showed that 24-28 day incubation with a mixed fungal/bacterial culture and mixed bacterial cultures gave 78-98% degradation (7 products) and 67-99% degradation (6 products), respectively. The mixed fungal/bacterial culture liberated carbon dioxide as 74-96% of the carbonyl label. TLC analysis indicated the major product formed by most cultures was 3,4-dichloroaniline. Detection of the demethylated derivatives, 3-(3,4-dichlorophenyl)-1-methyl urea and 3-(3,4-dichlorophenyl) urea, suggested a stepwise demethylation of diuron occurred. Similar studies with 2,6-dichlorobenzonitrile (dichlobenil) herbicide showed degradation products of 2,6-dichlorobenzoic acid and 2,6-dichlorobenzamide. (Zielinski-IPA)
W81-00110

SOURCES AND BEHAVIOR OF NATURAL RADIOACTIVITY IN FALL LINE AQUIFERS NEAR LEESVILLE, SOUTH CAROLINA,
South Carolina Univ., Columbia.
For primary bibliographic entry see Field 5A.
W81-00113

MODELING OF HEATED SURFACE JETS,
State Univ. of New York at Buffalo. Dept. of Mechanical Engineering.
R. Chang, L. Liu, C. Santanam, and L. A. Kennedy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-116857, Price codes: A09 in paper copy, A01 in microfiche. Final Technical Report prepared for Office of Water Research and Technology, September 1979, 179 p, 70 Fig, 2 Tab, 48 Ref, 2 Append. OWRT C-6038(No 5203)(1), 14-31-0001-5203.

Descriptors: *Thermal pollution, *Flow, *Stratified flow, *Thermal water, *Measurement, Computer models, Mathematical models, Jets, Surfaces, Turbulence, Temperature, Velocity, Reynolds number, Diffusion, Heat flow, Research equipment.

Laboratory studies of heated water jets were undertaken to model real-life discharges by thermal power plants. Thermal pollution can be controlled if there can be an accurate prediction of the water temperature and velocity distribution in the disposal area. A Laser-Doppler Velocimeter (LDV) system was developed to measure the velocity of the heated jets without the use of dyes or floating objects. The thermally stratified surface jets were analyzed at a particular Richardson Number and Reynolds Number. The turbulent entrainment of temperature stratified flows was also measured and the range of Reynolds numbers was quite narrow and the mixing coefficients were found to only be functions of the local Richardson number. Dye injection studies gave the centerline trajectories and plume widths by varying the four dimensionless parameters: Richardson number, velocity ratio, channel width, and jet aspect ratio. A numerical model was developed for predicting the behavior of a heated surface jet as it penetrates a quiescent body of water. The model uses the two equation K-epsilon turbulence model including bouyancy effects. Stability problems in the turbulence portion of the calculations gave anomalies such as overpredicted centerline temperatures far from the discharge point and under-prediction for the lateral spread of the jets for small values of the initial Richardson number. (Sidney-IPA)
W81-00114

PROCESS FOR CONCENTRATING TRITIUM AND/OR TRITIUM HYDRIDE AND SEPARATING IT FROM TRITIUM WATER,
Hoechst A.G., Frankfurt am Main (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W81-00126

HYDROGEOLOGIC DATA FOR THE MCKAY CREEK SUBSURFACE WASTE-INJECTION TEST SITE, PINELLAS COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 3C.
W81-00152

HYDROLOGY OF THE CHICOD CREEK BASIN, NORTH CAROLINA, PRIOR TO CHANNEL IMPROVEMENTS,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 4A.
W81-00154

THE BALTIC SYSTEMS OF MAN AND NATURE. A PERSPECTIVE FOR THIS ISSUE,
B.-O. Jansson.
Ambio, Vol 9, No 3-4, p 112-113, 1980. 1 Fig, 2 Ref.

Descriptors: *Water pollution, *Natural resources, *Water resources, *Environmental effects, *Oceans, Mine wastes, Municipal wastes, Industrial wastes, Water circulation, Marine fish, Sands, Fossil fuels, Urbanization, Planning, Waste water, Sea water, Baltic Sea, Water pollution control.

This introduction to a series of articles on the Baltic stresses the interrelationships between natural and man-made systems in this area. Natural

systems, including climate, inflowing water from rivers and from the North Sea, fish, and mineral products, are impacted by human exploitation and by the production of wastes, both water- and airborne. Wastes are the products of urban and industrial systems, such as the food industry and the exploitation of minerals. The use of fossil fuel has resulted in the introduction of nutrients but also of hazardous substances into the waste water flow. In the Baltic area, both governmental and non-governmental organizations are concerned with the scientific use of the Sea. Several conventions for protecting the Baltic from pollution have been agreed upon by its seven bordering states. (Gish-FRC)
W81-00202

POLLUTION FROM INDUSTRIES IN THE DRAINAGE AREA OF THE BALTIC,
Swedish Water and Air Pollution Research Lab., Stockholm.
L. Bruneau.
Ambio, Vol 9, No 3-4, p 145-152, 1980. 8 Fig, 8 Tab, 14 Ref.

Descriptors: *Industrial wastes, *Agricultural runoff, *Pulp wastes, *Pollutants, *Water pollution control, Baltic Sea, Oceans, Water pollution, Rivers, Lignins, Nitrogen, Phosphorus, Organic wastes, Copper, Fertilizers.

Pollution in the Baltic Sea by industrial activities in surrounding countries is reviewed. Possible ways in which the ever-increasing level of pollution can be monitored and eventually reduced are considered. The largest consumer of water among the industries in this region is the pulp and paper industry. Scandinavian countries have reduced the pollution from this industry, but there are still severe problems. Specific industrial problems are discussed for the Bothnian Bay area, the Bothnian Sea, the Gulf of Finland, the Gulf of Riga, and the Baltic itself. Estimated discharge figures in kilotonnes/yr are 0.006 (via rivers) for copper, 4.8 (57.4 via rivers) for nitrogen, 1.4 (0.76 via rivers) for phosphorus, 571.6 for lignin and 343.5 (201.5 via rivers) for BOD7. Estimates for chlorinated phenolic compounds are also given. Primary means of reducing pollution in this area of concern are noted. The most dramatic improvements in BOD and lignin discharge came about in the middle 1940s with the development of a process for evaporation and burning of sulfite liquors. Most of the improvements have been made in Sweden, with the other countries lagging behind. (Baker-FRC)
W81-00203

DEPOSITION OF AIRBORNE POLLUTANTS ON THE BALTIC,
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
H. Rodhe, R. Soderlund, and J. Ekstedt.
Ambio, Vol 9, No 3-4, p 168-173, 1980. 2 Fig, 8 Tab, 37 Ref.

Descriptors: *Precipitation, *Air-water interfaces, *Pollutants, *Water pollution sources, *Air pollution effects, Baltic Sea, Organic compounds, Nitrogen compounds, Lead, DDT, Polychlorinated biphenyls, Air pollution, Oceans.

The pollution of the Baltic Sea by airborne pollutants is considered with emphasis on the deposition process. Downward transport across the air-sea interface may be divided into wet deposition (fallout in precipitation) and dry deposition (gravitational setting, transport by turbulent eddies, molecular diffusion, and impaction by inertia). Deposition rates for a number of pollutants are given, suggesting that atmospheric deposition is a major source of nitrogen compounds (120,000-1.3 million tons/yr) and lead (600-5,000 tons/yr) in the contaminated Baltic Sea area. A meteorological study of the area indicates that the turnover time for water in the Baltic Sea is about 15 yr. Surface waters have a normally shorter residence time. Concentration data is provided for inorganic nonmetals, metals, radionuclides, and organic compounds in the Baltic Sea. The deposition of DDT and polychlorinated biphenyls in various areas of Sweden varies from 960 to 2,120 and 1,400 to 1,780 ng/sq m/month, respectively. Estimates of the annual flux of a number of pollutants from the atmosphere to the Baltic Sea have been calculated from the methods and data presented. (Baker-FRC)
W81-00204

MEDITERRANEAN STATES AGREE ON TREATY TO CONTROL LAND-BASED POLLUTION,
For primary bibliographic entry see Field 6E.
W81-00213

EFFECT OF SALINITY ON METHYLATION OF MERCURY,
Cook Coll., New Brunswick, NJ. Dept. of Biochemistry and Microbiology.
J. E. Blum, and R. Bartha.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 3, p 404-408, September, 1980. 1 Fig, 17 Ref.

Descriptors: *Salinity, *Mercury, *Estuarine environment, *Marine microorganisms, Inorganic compounds, Sediments, Anaerobic conditions, Incubation, Laboratory tests, Analytical techniques, Freshwater, Saline water.

The effects of salinity on microbial methylation of inorganic and phenylmercury compounds to mono- and dimethylmercury were evaluated utilizing sediments from an estuarine environment. Sediment samples collected from the Cheesequake Creek in New Jersey were slurried with water from a freshwater pond in a sediment to water ratio of 2:1 and then mixed with sea salts to achieve the desired salinity. To the slurry was added 10 ppm mercury as $HgCl_2$; some samples were mixed with 0.2% NaN_3 to suppress microbial methylation. Analysis of the samples indicated that the rate and extent of microbial methylation of mercury ions in anaerobically incubated estuarine sediment samples occurred in an inverse relationship to salinity, with methylation performed most rapidly at the lowest salinity of 0.1%. Methylmercury concentrations decreased after 15-20 days of incubation, and these decreases were attributed to microbial demethylation. Further studies on mercury methylation in freshwater and salt water were recommended. (Lisk-FRC)
W81-00217

ACCIDENTAL CHEMICAL SPILLS. A REVIEW OF INCIDENTS IN THE OHIO RIVER VALLEY, 1978 AND 1979,
R. C. Kroner.
Public Works, Vol 111, No 10, p 48-50, October, 1980. 1 Fig, 5 Tab.

Descriptors: *Ohio River, *Chemical wastes, *Accidents, *Water law, Law enforcement, Water pollution, Industrial wastes, Rivers, Organic wastes, Inorganic compounds, Oil pollution, Oil wastes, Sewage, Legislation, Water pollution control.

Information from reports on chemical spills filed with the Ohio River Valley Water Sanitation Commission according to federal law is presented in an attempt to acquaint the public with the spectrum of industrial materials which are escaping into the waterways of the Ohio River Valley. While it is acknowledged that merely cataloguing such incidents will not abate their occurrence, a periodic review of these happenings will indicate additional precautions and legislation that will aid in reducing their occurrence in the future. In 1978, a total of 150 spills was reported. In 1979, 161 such spills were reported. In the 2-yr period, there were more than 100 petroleum product spills, usually in the range of $<$ 100 to 1,000 gallons, though one loss in 1979 was of 45,000 gallons. Other spills in 1979 included raw sewage (30 million gallons), industrial waste mixtures (phenol, cyanide, oil, and greases, 36 million gallons; chlordane-hexachloropentadiene, 0.5 million gallons), formic acid - hydrochloric acid (0.19 million gallons), and carbon black (800 barrels). Miscellaneous wastes spilled into the Ohio in 1979 included steel mill sludge, pickle rinse, lime slurry, glass furnace sludge, and paint sludge. Multi-component spills are a common occurrence. Most spills occur in the most heavily industrialized areas, along the north bank of the Ohio along the Ohio state boundary. From Cincinnati to its confluence with the Mississippi, the river is almost spill-free. The number of spills reported by states in 1978 and 1979 ranged from 157 in Ohio to 2 in Illinois. Some reports received by lay people are based purely on visual observations. (Baker-FRC)
W81-00222

EVIDENCE FOR THE DECOUPLING OF DISSOLVED, PARTICULATE AND SURFACE MICROLAYER HYDROCARBONS IN NORTHWESTERN ATLANTIC CONTINENTAL SHELF WATERS,
Energy Resources Co., Inc., Cambridge, MA. Aquatic Sciences Div.
P. D. Boehm.
Marine Chemistry, Vol 9, No 4, p 255-281, August 1980. 7 Fig, 6 Tab, 38 Ref.

Descriptors: *Organic compounds, *Oil pollution, *Continental shelf, *Films, *Sea water, Water sampling, Dissolved solids, Pollutant identification, Gas chromatography, Water analysis, Chemical analysis, Oily water, Sampling.

Various stations set along the Georges Bank area off the New England coast were sampled to determine the seasonal, spatial and depth variations in dissolved, particulate and surface microlayer water. Large spatial and temporal heterogeneity was discovered in the origin of hydrocarbons upon analysis of water column samples by high-resolution gas chromatography. Surface film hydrocarbons were present at higher levels than dissolved fractions. Dissolved fractions were more abundant than particulate hydrocarbons in the water column. Surface film and dissolved hydrocarbons showed slight differences although both were mainly of a petroleum source. Bulk-water particulate was of a mixed biogenic and petrogenic origin. Due to the differences in hydrocarbons found in the surface microlayer and the bulk water, a microlayer enrichment factor was not considered. Hydrocarbons of the surface film, bulk water particulate matter and dissolved hydrocarbons were all decoupled with regard to origin and concentration in the area studied. (Geiger-FRC)
W81-00244

THE BIOGEOCHEMISTRY OF SEDIMENTS IN TWO GULF OF MAINE BASINS,
New Hampshire Univ., Durham. Dept. of Earth Sciences.
W. B. Lyons, M. E. Hines, G. M. Smith, and A. D. Hewitt.
Marine Chemistry, Vol 9, No 4, p 307-320, 1980. 1 Fig, 7 Tab, 60 Ref.

Descriptors: *Biochemistry, *Gulfs, *Maine, *Geochemistry, *Sediments, Analytical techniques, Nitrification, Marine bacteria, Carbon, Sedimentation rates, Sulfates, Denitrification, Water sampling, Sea water.

A preliminary study was made of deeper water continental shelf sediments off the Gulf of Maine Basins. Sediment from Jeffreys Basin exhibited low organic carbon content and low reduced sulfur values. The pore water values indicated that nitrification with subsequent denitrification were the major biogeochemical processes which were occurring in the upper 115 cm of the water. Wilkinson Basin sediments demonstrated higher organic carbon values and higher reduced sulfur and total plate-count bacteria. Thus the major biogeochemical processes occurring in these latter sediments were denitrification with sulfate reduction. The difference in sedimentation rates at the two basins is shown to influence the differences in the rates of the microbially mediated processes found in each basin. (Baker-FRC)
W81-00245

LAND-BASED INPUTS OF SOME MAJOR POLLUTANTS TO THE BALTIC SEA,
International Council for Exploration of the Sea,

Copenhagen (Denmark).
J. Pawlak.
Ambio, Vol 9, No 3-4, p 163-167, 1980. 3 Fig, 4 Tab, 11 Ref.

Descriptors: *Pollutants, *Organic wastes, *Domestic wastes, *Nitrogen, *Phosphorus, Industrial wastes, Water pollution sources, Baltic Sea, Sewage, Rivers, Heavy metals, Polychlorinated biphenyls, Pesticides, Oceans, Agricultural runoff, Nutrients, Pollutant identification.

Some of the major sources of pollutants to the Baltic Sea are discussed. Organized study of the input of pollutants to the Baltic Sea began about 1970 when the International Council for the Exploration of the Sea compiled estimates of domestic sewage and industrial discharge inputs. Currently, the fate of pollutants in the Baltic Sea and their exchange with other pollutants in the North Sea are being studied. Of all the pollutants present, the most reliable estimates for concentration are made of the organic matter and nutrients nitrogen and phosphorus. Sources of organic matter include untreated domestic sewage, effluents from food processing and paper and pulp industries, and humic substances in runoff water from agricultural sites. About half of the organic matter in the Baltic is transported there by the river systems. The annual input of phosphorus to the Baltic Sea is 25,825 tons, while that of nitrogen is 308,890 tons, and that of organic matter (estimated as BOD7) is 1,354,700 tons. Among industrial wastes in the Sea are heavy metals such as mercury, cadmium, lead, chromium, copper, zinc, nickel and iron. Organohalogen compounds such as polychlorinated biphenyls and certain pesticides are also present, along with petroleum hydrocarbons. (Baker-FRC)
W81-00247

5C. Effects Of Pollution

TESTS OF TWO FLUOROMETRIC ASSAYS FOR GONYAULAX AND APHANIZOMENON TOXINS,
New Hampshire Univ., Durham. Dept. of Biochemistry.
For primary bibliographic entry see Field 5A.
W81-00020

EFFECTS OF A HEPATIC TOXIN FROM THE CYANOPHYTE, MICROCYSTIS AERUGINOSA,
New Hampshire Univ., Durham. Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W81-00026

THE EFFECT OF CHEMICAL SPECIATION ON THE EQUILIBRIUM, WHOLE-BODY CADMIUM CONTENT OF LARVAE OF THE CADDISFLY, HYDROPSYCHE SP.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
S. A. Dressing.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-111304, Price codes: A05 in paper copy, A01 in microfiche. MS Thesis, 1980. 88 p, 9 Fig, 19 Tab. OWRT-A-095-NC (2), 14-34-0001-9035.

Descriptors: *Cadmium, Heavy metals, *Aquatic organisms, Cadmium in water, Cadmium in organisms, *Caddisflies, Aquatic insects, Reproduction, Larvae, Toxicity, Testing procedures.

The correlations between heavy metal concentrations in caddisfly larvae and both total cadmium and free cadmium ion concentrations were studied in the laboratory to determine the effect of chemical speciation on the equilibrium cadmium burden of the caddisfly larvae. Nitrilotriacetic acid (NTA) was added to inorganic test media to serve as a chelator. Cadmium in water and test organisms was determined by both graphite furnace atomic absorption spectrophotometry (GFAAS) and conventional flame atomic absorption spectrophotometry (FAAS). Cadmium speciation was calculated by the REDEQL2 chemical equilibrium computer program. Organism cadmium concentration was found to be a function of the total cadmium concentration in the media, not the free cadmium ion concentration. The biological variation inherent in the test organisms was found to be the largest factor limiting the experimental reproducibility, but replicate test systems produced very similar results.
W81-00030

EFFECT OF AGRICULTURAL LAND DEVELOPMENT ON DRAINAGE WATERS IN THE NORTH CAROLINA TIDEWATER REGION,
North Carolina State Univ. at Raleigh. School of Agriculture and Life Sciences.
R. W. Skaggs, J. W. Gilliam, T. J. Sheets, and J. S. Barnes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-105959, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Institute of The University of North Carolina, Raliegh, Report No 159, 1980. 110 p, 49 Fig, 48 Tab. OWRT-B-102-NC (1), 14-34-0001-7174.

Descriptors: *Drainage effects, *Water quality, Water quantity, Agricultural drainage, *Agricultural runoff, Nutrients, Phosphorus, Nitrogen, Pesticides, Soil properties, Rainfall, Water analysis, Soil analysis, Chemical analysis, Tidewater Region(NC).

A three year study was conducted to determine the effects of agricultural drainage and development on hydrology and runoff water quality on high organic soils in the North Carolina Tidewater Region. Experiments were conducted on paired developed and undeveloped sites of three different soils that span the range of soils being developed in the Tidewater Region. Each of the six sites (three developed, three undeveloped) were instrumented to continuously measure the rate of runoff, to sample for water quality and pesticide analyses, and to determine other variables such as rainfall and water table depth. Peak runoff rates occur earlier and are three to four times higher on developed than on similiar undeveloped lands. There is a small but significant increase in inorganic nitrogen in drainage water as a result of agricultural development of these organic rich soils. However, the true organic soils which are developed lose considerably more phosphorus to drainage waters. Development of the mineral soil has a very small effect on phosphorus losses. One potential water quality problem is the movement of fecal organisms from grazed pastures into drainage water.
W81-00037

THERMAL EFFECTS ON PRIMARY PRODUCTIVITY OF PHYTOPLANKTON, PERIPHYTON AND MACROPHYTES IN LAKE KEOWEE, SOUTH CAROLINA,
Clemson Univ., SC. Water Resources Research Inst.
C. R. Dillon, and J. H. Rodgers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-112435, Price codes: A06 in paper copy, A01 in microfiche. Report No 81, 1980, 115 p, 8 Fig, 8 Tab, Append. OWRT B-053-SC (1).

Descriptors: *Primary productivity, Thermal loading, *Phytoplankton, *Periphyton, Macrophytes, *Thermal pollution, Lakes, *Nuclear powerplants, Environmental effects, Nutrients, Water quality, Aquatic plants, Growth rates, South Carolina, *Lake Keowee(SC).

Productivity of phytoplankton, periphyton and macrophytes at three stations in Lake Keowee was measured from April, 1973 to April, 1975. Average monthly productivity for phytoplankton was 1097.19, 1037.33 and 880.54 mg C m super -2 m0 super -1 at Stations 1, 2, and 3 respectively. Monthly averages of periphyton productivity were 158.63, 108.87 and 211.39 mg C m super -2 mo super -1 for Stations 1, 2 and 3 respectively. Macrophytes occurred only at Station 3. For the fourteen months they were present, macrophytes averaged 660.4 mg C m super -2 mo super -1. Ludwigia palustris (L.) E., and Potamogeton diversifolius Raf., previously unreported from Oconee County, were the only submerged aquatic macrophytes found. From the thermal profiles there tended to be an autumnal turnover. Based on the temperature data, Lake Keowee would be classified as a warm, monomutic lake. Both low nutrient concentrations and low productivity classifies Lake Keowee as an oligitrophic lake. This investigation could demonstrate no significant effect of thermally elevated reactor cooling effluents on the productivity of phytoplankton or periphyton. The occurrence of macrophytes only in the thermally affected area is considered to be an artifact of substrate coupled with the possibility that some additional effect may be realized from water currents generated by pumping action.
W81-00038

EFFECTS OF ATRAZINE ON CHESAPEAKE BAY AQUATIC PLANTS,
Auburn Univ., AL. Dept. of Botany, Plant Pathology, and Microbiology.
D. R. Forney.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-115560, Price codes: A05 in paper copy, A01 in microfiche. Master of Science Thesis, August 26, 1980. 86 p, 1 Fig, 13 Tab, 83 Ref. OWRT-A-067-ALA(1).

Descriptors: *Triazine pesticides, *Water pollution effects, *Water pollution sources, *Aquatic plants, *Chesapeake Bay, Pesticides, Chlorinated hydrocarbons, Agricultural runoff, Toxicity, Toxins, Environmental effects, Plant pathology, Halogenated pesticides, Alabama, Water pollution, Plant growth, Growth chambers.

The possibility of atrazine runoff from farmland being involved in the observed decline in submerged plant populations in Chesapeake Bay in recent years, was investigated using growth chamber studies. Dose-reponse studies using elodea and redheadgrass plants grown in jars in nutrient solution containing varying atrazine concentrations showed the 1% growth inhibition concentration level to be a few parts per billion (ppb) atrazine. A somewhat higher atrazine concentration gave a 1% inhibition of Eurasian watermilfoil growth. Atrazine concentrations calculated for 50% growth inhibition were 13 ppb for elodea, 163 ppb for wildcelery, 474 ppb for redheadgrass, and 1104 ppb for Eurasian watermilfoil. While growth of the brackish species wildcelery was inhibited both by salinity and by atrazine, no significant inhibition interaction was observed for these variables. When low atrazine levels were present in both the water and the soil, the water concentration determined the toxic event. Soil concentrations of atrazine less than 1000 ppb had no effect. The study concludes that, from the atrazine concentrations detected in Chesapeake Bay samples, atrazine was not likely to have caused the observed decline of submerged plants in the Bay. (Zielinski-IPA)
W81-00046

LIMNOLOGY OF LAGO LOIZA, PUERTO RICO,
Geological Survey, San Juan, PR. Water Resources Div.
F. Quinones-Marquez.
Geological Survey Water-Resources Investigations 79-97, February 1980. 113 p, 44 Fig, 26 Tab, 48 Ref.

Descriptors: *Limnology, *Water quality, *Lakes, *Puerto Rico, *Eutrophication, Chemical properties, Physical properties, Biological properties, Sediments, Reservoirs, Storage capacity, Hydrologic budget, Bacteria, Dissolved oxygen, Water temperature, Nutrients, Plankton, Hydrologic data, *Lago Loiza(PR).

The principal chemical, physical and biological characteristics of Lago Loize, P.R., and its main tributaries were studied from 1973-74. The lake supplies an average of 300,000 cubic meters per day of water to metropolitan San Juan. Flows from Rio Grande de Loize and Rio Gurabo contribute 84.0 percent of the water, 67.3 percent of the nitrogen, and 66.8 percent of the phosphorus to the lake. About 31 percent of the nitrogen and 45

percent of the phosphorus were retained in the lake, which has a mean flusing rate of 19 times per year. The lake's capacity declines at a rate of about 1.9 percent per year and is about 14.9 million cubic meters. Sewage inputs to the lake's tributaries average 18,560 cubic meters per day. Fecal coliform bacteria in numbers ranging from 100 to 6,700,000 were recorded throughout the tributaries and the lake. In the lake, dissolved oxygen concentration is less than 5.0 milligrams per liter below the 1.5-meter depth. Lago Loize is a hypereutrophic lake, with an average total nitrogen concentration of 1.7 milligrams per liter and 0.33 milligram per liter of total phosphorus. (USGS)
W81-00067

EFFECT OF FLUCTUATING RESERVOIR RELEASE ON THE DOWNSTREAM ENVIRONMENT,
Michigan Technological Univ., Houghton. Dept. of Biological Sciences.
For primary bibliographic entry see Field 4A.
W81-00087

THERMAL STRESS STUDIES ON SELECTED ZOOPLANKTON SPECIES AND AN ISOPOD,
Tennessee Univ., Knoxville. Dept. of Zoology.
D. L. Bunting, and N. J. Cheper.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-115610, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Center. University of Tennessee Report No 76, June 1980. 50 p, 6 Fig, 7 Tab, 76 Ref. OWRT-A-049-TENN(1), 14-34-0001-0145.

Descriptors: *Zooplankton, *Thermal pollution, *Water temperature, *Cooling water, *Industrial water, Industries, Industrial wastes, Recirculated water, Industrial plants, Aquatic microorganisms, Aquatic life, Water utilization, Water resources, Water supply, Heat pollution, Heated water, Water pollution sources.

Laboratory determination of temperature stress levels and assessment of their ecological consequences was carried out for selected zooplankton species to develop data for ecological impact associated with industrial use of natural water for cooling. An included literature search revealed substantial fish and benthos data, but little on stress temperature effects on zooplankton. Information was gathered on two cladocerans (Daphnia pulex and Simocephalus exspinosus), four copepods (Mesocyclops edax, Diaptomus reighardi, D. stagnalis, and D. clavipes), and an isopod (Lirceus brachyurus). The time lapse until 95% mortality was determined for D. pulex immatures acclimated at 15 and 25 degrees C, and the lethal temperature causing 50% mortality was determined for adult and immature S. exspinosus acclimated at 15 degrees C and tested at 20, 25, and 30 degrees c. A general trend was observed for the time to mortality to increase with acclimation temperature increase; and for a given acclimation temperature, for mortality time to decrease with increasing test temperatures (25-35 degrees C). Time estimates to 50% mortality for the copepods suggested that intersex tolerance differed at specific temperatures, but, overall, increasing test temperatures decreased survival time. Isopod survival increased with increasing acclimation temperature. Suggested future research included modeling of the effects noted, based on a detailed field study of secondary production. (Zielinski-IPA)
W81-00090

EFFECTS OF AGRICULTURAL DRAINAGE DEVELOPMENT ON BENTHIC INVERTEBRATES IN UNDISTURBED DOWNSTREAM REACHES,
Minnesota Univ., St. Paul.
P. C. Marsh, and T. F. Waters.
Transactions of the American Fisheries Society, Vol 109, No 2, p 213-223, March 1980. 2 Fig, 5 Tab, 25 Ref. OWRT-B-120-MINN(2), 14-31-0001-6091.

Descriptors: *Channel improvement, *Agricultural runoff, *Effects, *Invertebrates, Insects, Benthic fauna, Sediments, Suspended solids, Turbidity, Streams, Runoff, Water chemistry, Water temperature, Dissolved oxygen, Hydrogen ion concentration, Carbon dioxide, Discharge(Water), Streamflow, Sampling, Surveys.

The downstream effects of channelization and agricultural drainage development were evaluated in southwestern Minnesota by comparing benthic invertebrate populations in streams heavily modified by channelization and agricultural drainage development in upstream areas with those not so modified. Physicochemical characteristics, as well as invertebrate populations, were observed in relatively undisturbed downstream reaches. Turbidity, total alkalinity, and timing of discharge were similar in all streams. Species compositions of benthic invertebrates were similar in all streams, and there were no significant differences in total, seasonal, or monthly levels of standing stock in either numbers or biomass between modified and unmodified streams. Invertebrate drift, both insects and total invertebrates, was similar in all streams. Some differences in individual taxa were observed, but these were related to localized differences between streams rather than to drainage development. Specific differences included higher numbers in drift of the snail Physa gyrina and the amphipod Hyalella azteca in one modified stream, apparently the result of more suitable upstream habitat in drainage ditches. It was concluded that, in these agricultural areas, the impact of upstream drainage development on benthic invertebrates in natural downstream reaches was negligible. (Sims-ISWS)
W81-00103

SOURCES AND EFFECTS OF COLOR IN THE WISCONSIN RIVER, WISCONSIN,
Wisconsin Univ.-Stevens Point. Coll. of Natural Resources.
C. Mechenich, B. H. Shaw, and T. S. Roeder.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-113342, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Center, University of Wisconsin, Madison, Technical Report WIS-WRC 80-09, 1980. 52 p, 6 Fig, 9 Tab, 47 Ref, 3 Append. OWRT-A-080-WIS, 14-34-0001-8053, 14-34-0001-9053.

Descriptors: Color, Light, Water quality, Wisconsin, Waste water disposal, Federal Water Pollution Control Act, Light penetration, Algae, *Pulp and paper industry, *Waste water(Pollution), *Color reactions, *Environmental effects, *Wisconsin River.

The Wisconsin River has been extensively used for power production and industrial and municipal wastewater disposal. Man's past uses of the river caused serious water quality problems. However, water quality in the Wisconsin River has substantially improved since the implementation of the wastewater treatments requirements of the 1972 amendments to the Federal Water Pollution Control Act (PL 92-500). Presently, wastewater discharges from the pulp and paper industry, especially during periods of low flow, influence the color of the Wisconsin River. The effect of color and associated effects of light penetration on the growth of algae in Lake Du Bay were investigated. Carbon assimilation rates increased as water color decreased, except for occasional instances of surface inhibition. Changes in carbon (C) assimilation rates varied with depth. Multiple regression analysis indicated that red light penetration was the most significant predictor of C assimilation rate changes. The contribution of industry to true and apparent color of the Wisconsin River appears to lower algal productivity in reservoirs. Further restrictions of industrial discharges without simultaneous reductions in nutrient pollution could cause more severe algal bloom problems than presently exist. Such relationships must be considered seriously in water quality planning and implementation of the provisions of PL 92-500.
W81-00107

INFLUENCE OF 2,4-D AND 2,4,5-T ON LIFE HISTORY CHARACTERISTICS OF CHIRONOMUS (DIPTERA: CHIRONOMIDAE),
Clemson Univ., SC. Dept. of Zoology.
C. F. Sigmon.
Bulletin of Environmental Contamination and Toxicology, Vol 21, p 596-599, 1979. 2 Tab, 11 Ref. OWRT-A-038-SC(2).

Descriptors: *Pollutants, *Aquatic life, *Midges, *Diptera, *2,4-D, *2,4,5-T, *Bioassay, *Lethal limit, *Toxicity, Water pollution sources, Water pollution, Water quality, Water pollution effects, Insects, Herbicides, Mortality, Pesticide residues, Toxins, Population, Inhibitors, Safety, Sewerage, Sewage treatment, Sewers, Agricultural runoff.

This study was designed to examine the effect of the butoxyethanol esters of 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) on pupation, emergence, and mortality in Chironomus sp. Combinations of the herbicide concentrations and temperatures chosen for study were similar to those observed in nature. Chironomus (midges) were collected from a sewage oxidation pond and sorted into three size classes. Ten animals/class were placed in culture dishes with fresh lake water and acclimated under incubation to 20, 25, or 30 degrees, followed by exposure to 1 or 3 ppm (acid equivalent) of either of the two herbicides. The only responses that appeared notable relative to controls were increased larval mortality, and decreased pupation and emergence at 30 degrees for 2,4-D. Although midges adequately withstood the herbicides at lower temperatures, the combined stress of temperature and herbicide was less well tolerated. While lethality studies on aquatic animals related to concerns for agriculture/forest runoff and aquatic weed control involving 2,4-D and 2,4,5-T have been reported, sublethality studies have been scarce. In the present study, control versus treatment differences were not sufficiently great to severely limit organisms such as midges which produce large numbers of eggs. (Zielinski-IPA)
W81-00116

OXYGEN CONSUMPTION IN LEPOMIS MACHROCHIRUS EXPOSED TO 2,4-D OR 2,4,5-T,
Clemson Univ., SC. Dept. of Zoology.
C. Sigmon.
Bulletin of Environmental Contamination and Toxicology, Vol 21, p 826-830, 1979. 2 Tab, 11 Ref. OWRT-A-038-SC(3).

Descriptors: *Herbicides, *2,4-D, *2,4,5-T, *Oxygen demand, *Respiration, *Sunfishes, *Fish behavior, *Water pollution effects, Pesticides, Oxygen requirements, Fish, Fish toxins, Water pollution, Water quality, Environmental effects, Pesticide residues, Mathematical models, Analytical techniques, Gas chromatography, Metabolism, Mathematical studies, Absorption.

Metabolic response was examined soon after exposure to 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) herbicides and short-term uptake by Lepomis macrochirus (bluegill sunfish) was determined. Short time periods were used since herbicides dissipate readily and fish would only be exposed to relatively high concentrations soon after herbicide application. Respiration was measured at 20, 25, and 30 degrees. Herbicide uptake was determined on fish maintained eight days at 20, 25, or 30 degrees in 3 ppm of 2,4-D or 2,4,5-T. A stepwise multiple regression was used to test the importance of herbicides, temperatures, and fish weight in predicting log-transformed respiration. The log transformation allowed comparison with other fish respiration data. Data were consistent with the hypotheses that the response of respiration to weight was independent of temperature. The influence of temperature on respiration was evident from the intercepts with elevated respiration at 30 degrees. More 2,4,5-T than 2,4-D was retained by the fish. Respiration was measured using a closed system and the azide modification of the Winkler technique. Herbicide levels in fish were determined as their methyl esters by analysis of cleaned-up extracts using gas-liquid chromatography with electron capture detection. (Zielinski-IPA)
W81-00117

OXYGEN CONSUMPTION IN DAPHNIA PULEX EXPOSED TO 2,4-D OR 2,4,5-T,
Clemson Univ., SC. Dept. of Zoology.
C. Sigmon.
Bulletin of Environmental Contamination and Toxicology, Vol 21, p 822-825, 1979. 2 Tab, 6 Fig. OWRT-A-038-SC (4).

Descriptors: *Pollutants, *Aquatic life, *Oxygen demand, *2,4-D, *2,4,5-T, *Bioassay, Toxicity, Water pollution sources, Water pollution, Physiological ecology, Water quality, Water pollution effects, Herbicides, Pesticide residues, Agricultural runoff, Toxins, Inhibitors, Safety, Thermal stress, Water temperature, Lakes, Ponds.

The effect of the butoxyethanol esters of 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) on oxygen consumption was studied in Daphnia pulex, an important freshwater animal due to its role as a food chain intermediate in temperature-zone lakes/ponds receiving agricultural runoff. Oxygen consumption is a useful measure of sublethal effects since energy processes serve to indicate the overall physiological activity state. Daphnia were laboratory cultured in pond water and acclimated at 20, 25, or 30 degrees with a 12-hour light, 12-hour dark photoperiod. Daphnia were maintained under incubation for one day prior to respiration measurement at 20 degrees, but were maintained under incubation for several days prior to respiration measurement at 25 and 30 degrees. Herbicide exposure (1 or 3 ppm pondwater solutions) was made shortly before oxygen consumption measurement. While both herbicides appeared to increase respiration at 30 degrees, statistical significance was only achieved for 2,4,5-T (at 3 ppm). Variability in the data was observed. The sharp increase noted for treatment with 3 ppm 2,4,5-T at 30 degrees could have been the result of the net effect of herbicide and temperature, analogous to an earlier proposition for sharp increases in the oxygen consumption-temperature curve for physiological systems. (Zielinski-IPA)
W81-00118

MAN'S IMPACT ON THE BALTIC ECOSYSTEM,
Abo Akademi, Turku (Finland). Inst. of Biology.
E. Leppakoski.
Ambio, Vol 9, No 3-4, p 174-181, 1980. 8 Fig, 3 Tab, 50 Ref.

Descriptors: *Ecosystems, *Balance of nature, *Baltic Sea, *Water pollution effects, *Aquatic life, Oceans, Land use, Eutrophication, Oxygen, Plankton, Water pollution control, Mercury, Heavy metals, DDT, Polychlorinated biphenyls, Aquatic animals, Fish, Water birds, Oil pollution, Water pollution sources, Industrial wastes, Chemical wastes.

Man's activities in the area of the Baltic Sea have resulted in excessive eutrophication and damaging oil spills, as well as contamination with industrial wastes such as heavy metals and toxic substances like polychlorinated biphenyls (PCBs). The biomass of the Baltic area is seriously affected. Changes in species composition have occurred, some being in danger of extinction (e.g. osprey, seals) and some having been introduced to the area (e.g. muskrat, Chinese mitten crab, herring gull). Excess eutrophication speeds up the development of anoxic conditions in stagnating bottom water and in the formation of hydrogen sulfide in the semi-isolated deep basins of the southern and central Baltic, causing heavy blooms of planktonic algae and decreased transparency of the water. Periods of oxygen depletion have been becoming longer and more frequent since the 1950s, and bottom areas devoid of macroscopic life increased up to 1972 (69,000 sq km in the Gotland Deep) but decreased slightly in 1973 (56,000 sq km). The most severe pollutant problem in the Baltic appears to be PCBs, with the concentration of PCBs in guillemot eggs rising from < 300 mg/kg in 1968 to > 350 mg/kg in 1975, peaking in 1973 at > 400 mg/kg. During the last 10 yr, the concentrations of mercury in fish from certain coastal areas has decreased to one-third earlier amounts. Concentrations of DDT have also begun to fall since the use of these products has been restricted; however, in 1975, the average content of DDT in guillemot eggs was about 450 mg/kg. It is not possible to assess the full impact of human activities on the Baltic Sea's ecosystem, though it seems unlikely that pollution control and cleanup measures can completely counteract the effects of overexploitation of fish resources, chemical pollution, introduction of new species, and land mismanagement. (Baker-FRC)
W81-00201

THE EFFECT OF INORGANIC AND ORGANIC MERCURY ON GROWTH KINETICS OF NITZSCHIA ACICULARIS W. SM. AND TETRASELMIS SUECICA BUTCH,
Santiago Univ. (Spain). Dept. of Microbiology.
B. Mora, and J. Fabregas.
Canadian Journal of Microbiology, Vol 26, No 8, p 930-937, August, 1980. 4 Fig, 6 Tab, 28 Ref.

Descriptors: *Phytoplankton, *Mercury, *Toxicity, *Growth rates, *Fluorescence, Analytical techniques, Diatoms, Inorganic compounds, Organic compounds, Salts, Marine algae, Bioassay.

The effects on two species of marine planktonic algae (Nitzschia acicularis and Tetraselmis suecica) from the northwest coast of Spain of mercury in the form of inorganic salts (HgC12, HgSO4, or NH2HgC1) and organic salts (CH3HgC1 and phenylmercuric acetate, PMA) were assessed by means of growth kinetics and in vivo fluorescence monitoring. Mercury concentrations ranged from 0 to 1.6 ppm. Data was analyzed by linear regression and by correlation. Addition of mercury at a concentration of 0.05 ppm in any of the three inorganic forms resulted in diminution of the lag phase and/or an increase in exponential growth; both species reached a final cellular density similar to or higher than the control. A linear relationship existed for both species between duration of the lag phase and mercury concentrations in the form of HgSO4. The organic forms of mercury were more toxic than the inorganic forms for both species. N. acicularis failed to grow at any of the test concentrations of PMA, and, at 0.05 ppm Hg, T. suecica indicated internal disorganization and loss of fluorescence. However, at 0.025 ppm Hg (PMA), this species indicated growth after 12 days of inactivity. For CH3HgCl, there was no growth for 15 days even at 0.025 ppm, the lowest concentration, though at the end of the experiment, 66% of T. suecica cells appeared enlarged. Higher concentrations of mercury that still permitted cell growth nevertheless affected chlorophyll fluorescence in central cellular areas, and the cells also appeared slimmed. (Gish-FRC)
W81-00210

LAKE GENEVA (LEMAN): RESTORING THE BALANCE,
Foundation Ripaille, Thonon-les-Bains (France).
E. Neckler.
Environmental Conservation, Vol 7, No 2, p 122-124, Summer, 1980.

Descriptors: *Lakes, *Lake Geneva, *Eutrophication, *Water pollution effects, *Nutrient removal, Conferences, Water pollution, Phosphorus, Nitrogen, Fertilizers, Herbicides, Pesticides, Oil pollution, Legislation, Water purification, Nutrients, Biological treatment, Chemical degradation, Sewage disposal, Agricultural runoff, Water pollution control.

The findings and conclusions of a symposium on the conservation and pollution problems of Lake Geneva are reported. Since the 1950s, the Lake has become eutrophic, mainly due to the constant influx of residual waters bearing excessive loads of nutrient elements, including nitrogen and phosphorus. Algae and phytoplankton have proliferated, the waters have clouded, and fish with low oxygen requirements are proliferating at the expense of those with high oxygen requirements. A network of water purification centers provides mechanical, chemical, and biological purification (the latter has now achieved 90% efficiency despite variation in sewage). Phosphorus is the worst pollutant of recent years, and to reduce this problem, France and Switzerland have banned the sale of washing powders with < 80% biodegradability. Efforts are being made to educate farmers to use less fertilizer in an attempt to reduce mud effluent containing phosphorus and nitrogen. Weed killers and pesticides represent only 1% of fertilizers used in the Lake area and are not a pollution threat. Streams containing rains that fall on roadways contain salt and hydrocarbons in increasing amounts. The symposium was in favor of putting restraints on the horsepower of motorboats used on the Lake; means of controlling oil pollution are already in effect. The best hope of restoring the Lake to an acceptable degree of purity lies in alerting residents of the Lake area to the condition of the Lake and to the danger of its relapse. (Gish-FRC)
W81-00215

BIOCHEMICAL AND HEMATOLOGICAL EFFECTS OF A TITANIUM DIOXIDE INDUSTRIAL EFFLUENT ON FISH,
Swedish Environment Protection Board, Studsvik. Brackish Water Toxicology Lab.
A. Larsson, K.-J. Lehtinen, and C. Haux.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 3, p 427-435, September, 1980.

Descriptors: *Titanium, *Bottom fish, *Fish physiology, *Heavy metals, *Iron compounds, *Sulfur compounds, Acidic water, Acidity, Water pollution effects, Bioassay, Toxicity, Zinc, Lead, Cadmium, Copper, Industrial wastes, Brackish water.

Flounders (Platichthys flesus) were exposed under continuous flow conditions for 14 days to 370 or 685 microliters/liter brackish water of titaniumdioxide industrial effluent from a plant on the southwest coast of Finland. The effluent contained 4% iron sulfate, 3% sulfuric acid, and heavy metal concentrations in undiluted effluent of 33.60 micrograms zinc, 0.22 micrograms lead, 0.12 micrograms cadmium, and 1.50 micrograms copper/liter. When discharged into the recipient water near the plant, the extremely acid effluent increases pH and results in precipitation of the heavy metals. Studies have demonstrated that the effluent is deleterious to bottom dwelling organisms and fishes; a brown precipitate formed on the gills of Perca fluviatilis and Alburnus alburnus when they were exposed to low concentrations of the effluent for 2-4 weeks. Exposure of flounder to the effluent resulted in enhanced levels of blood glucose ($p = 0.001$) and blood lactate ($p = 0.007$), and elevated levels of hematocrit and hemoglobin in females. The observed disturbances were attributed to strictly mechanical actions of the precipitate on gill tissue or a disturbed gill function caused by the biochemical action of heavy metals present in the precipitate. Hematological disturbances may be caused by stress induced by exposure to the effluent. (Lisk-FRC)
W81-00218

5D. Waste Treatment Processes

REMOVAL OF HYDROCARBON POLLUTANTS FROM WATER BY PROTOTHECA ZOPFII,
West Virginia Univ., Morgantown. Water Research Inst.
R. S. Pore.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-110769, Price codes: A03 in paper copy, A01 in microfiche. Technical Completion Report, 1980. 34 p, 5 Fig, 5 Tab, 12 Ref. OWRT-A-041-WVA (1), 14-34-0001-0152.

Descriptors: Algae, *Biological treatment, *Microorganisms, *Organic compounds, Treatment, Waste water treatment, *Water treatment, Aquatic microorganisms, Biodegradation, Ecosystems, Methodology, Microbial degradation, Organic wastes, Toxicity, Pollutants, Water pollution, Pesticides, Pesticide removal, Prototheca zopfii, Kepone.

Bioaccumulation of Kepone and some other chemical pollutants from aquatic sources was

greatly enchanced by passage through a fixed-bed column containing the immobilized alga Prototheca zopfii. The living algae, immobilized in agar beads, removed the trace-level pollutants with an efficiency equal to or greater than activated charcoal. Hydrophobic partitioning was not the mechanism of bioaccumulation for the hydrophobic Mirex and Aflatoxin G (1) were not bioaccumulated, and metabolic inhibitors blocked bioaccumulation. The pollutants were stored, as the algae were incapable of biodegrading them. The pollutants with the greatest affinity for bioaccumulation were preferentially adsorbed in the presence of a mixture of different pollutants. The chemical recognition for bioaccumulation was very specific, and when it occurred, as in the case of Kepone, concentration factors on the order of 1,000,000 were obtained. The model system shows promise for several waste-water-treatment applications and for basic studies in bioconcentration.
W81-00016

THE SURVIVAL OF PATHOGENS DURING THE COMPOSTING OF WASTEWATER SLUDGE,
New Hampshire Univ., Durham. Dept. of Civil Engineering.
M. N. Flinkstrom.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-109811, Price codes: A06 in paper copy, A01 in microfiche. Master of Science Thesis, 1980. 96 p, 16 Fig, 13 Tab, 23 Ref, 3 Append. OWRT B-006-NH (1), 14-34-0001-0272.

Descriptors: *Decomposing organic matter, *Domestic wastes, *Sewage treatment, *Aerobic treatment, *Streptococcus, Organic wastes, Sludge, Aeration, Municipal Wastes, Sewage, Solid wastes, Aerobic bacteria, Sewage bacteria, Coliforms, Pathogenic fungi, Biodegradation, Pathogenic bacteria, Composting, Sludge composting, Sludge treatment, New Hampshire, Forced aeration composting, Wastewater sludge disposal, Domestic wastewater sludge, Static pile composting.

Two complete composting periods, including active composting by static pile forced aeration and curing were monitored in this study. Samples from four sites representing interior and exterior portions of the compost pile were collected regularly. The survival of two groups of bacterial indicators, fecal coliform and fecal streptococcus, and one fungus, Aspergillus fumigatus, were monitored during the two composting periods studied. Temperature, pH, moisture content, and carbon:nitrogen ratio of the compost material were also monitored. Data collected indicated that the organisms studied here were virtually eliminated during the composting of raw wastewater sludge. Temperature within the compost mass had the greatest effect on the survival of the organisms, but many factors were responsible for the patterns of survival and destruction noted.
W81-00022

A TRIHALOMETHANE STUDY OF THE DURHAM, NEW HAMPSHIRE WATER TREATMENT PLANT,
New Hampshire Univ., Durham. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W81-00033

THE EFFECT OF PROCESS DESIGN ON REDUCED WATER USE AND WASTE IN DAIRY PROCESSING,
North Carolina State Univ. at Raleigh.
R. E. Carawan, and W. J. Harper.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-110330, Price codes: A11 in paper copy, A01 in microfiche. Water Resources Center. The Ohio State University, Columbus, Project Completion Report 502X. June 1980, 217 p, 18 Fig, 59 Tab, 218 Ref. OWRT-A-043 OHIO (2).

Descriptors: *Dairy industry, *Waste water treatment, *Sewerage, Model studies, Water pollution control, Costs, Industrial wastes, Municipal sewer system.

Procedures were developed for evaluating management and process modification in dairy plants to minimize water use and resource losses. The study utilized a medium sized, multi-product dairy plant as a model for the study. Water use, wastewater discharge, product loss and waste contribution was determined for each unit process. Waste parameters evaluated emphasized water volume, biochemical oxygen demand (BOD) and fats, oils and grease (FOD). Alternative processes were selected for reduction of water and wastes and evaluated for cost effectiveness. A linear program model was developed for the model plant on a unit processes basis and solutions obtained to evaluate the effects of process modifications, effluent restrictions and costs of water and waste discharges on cost effectiveness of the model plant and the model plant after process modifications. Without process modifications an effluent limitation of 2000 mg/1 BOD would shut down ice cream and cottage cheese operations and results in a 75% reduction of milk processing. With all available process modifications, the plant could process 100% of milk and ice cream and 23% of the cottage cheese.
W81-00035

ANALYSIS OF THE CHEMISTRY ASSOCIATED WITH OZONOLYSIS OF ORGANIC POLLUTANT MOLECULES IN WATER,
Wesleyan Univ., Middletown, CT.
W. Pringle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-115651, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, September 16, 1980. 8 p, 2 Fig, 12 Ref. OWRT-A-070-CONN(1).

Descriptors: *Water pollution, *Waste water treatment, *Chemical reactions, *Kinetics, *Toxins, *Analytical techniques, Assay, Waste treatment, Water quality, Water chemistry, Chemistry, Pollutants, Water pollution sources, Pollutant identification, Poly-chlorinated biphenyls, Water pollution treatment, Chemical analysis, Investigations, Chlorination.

This study sought to examine the chemistry and rates of chemical oxidation and to identify compounds residual from ozonation of organics identified in sewage treatment plant water. An all-glass system was constructed to ozonize aqueous solutions of trace organics, modified to contain quartz reaction cells for UV irradiation and to reduce sparging. Products and product yield rates were determined by instrumental analysis, including gas chromatography (GC), GC-mass spectrometry, pulsed Fourier transform nuclear magnetic resonance, and an assembled linear array photo-detector-computer system for laser-induced narrow-line low-temperature fluorescence spectra of trace organic concentrations. Toxic compounds studied for ozonation, oxidation products analysis, and reaction kinetics were phenol, the three chlorophenol isomers, dibenzofurane as a model for its toxic chlorinated analogs, and chloroform. Large differences were noted in the ozonolysis rates of the three chlorophenol isomers. It was also determinated that dibenzofurane ozonolysis was much faster in water than in organic solvents. Matrix isolation fluorescence was also examined as a trace technique for polycyclic aromatic hydrocargons. It was sought to study ozonolysis to determine conditions for removal of toxic or suspect carcinogens resulting from chlorine treatment of sewage organics. (Zielinski-IPA)
W81-00093

APPLICATION OF THE AEROBIC-MEDIA TRICKLING FILTER TO NITROGEN CONTROL IN WASTEWATER TREATMENT,
West Virginia Univ., Morgantown. Water Research Inst.
C. R. Jenkins, G. K. Bissonnette, P. B. Huff, and G. W. Gillespie.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-118762, Price codes: A03 in paper copy, A01 in microfiche. Information Report 14, 1980. 40 p, 11 Fig, 12 Tab, 54 Ref. OWRT-A-036-WVA(3), 14-34-0001-8052.

Descriptors: *Aerobic treatment, Equipment, *Nitrification, Oxygenation, *Sewage treatment, *Trickling filters, *Waste water treatment, Aeration, Biological treatment, Filters, Nitrogen, Oxygen, Secondary treatment, Solids contact processes, Treatment, Wastes, Waste treatment, Water pollution treatment.

Chemical and microbiological evaluation of a bench-scale aerobic-media trickling filter (AMTF) showed the system to be successful in promoting rapid nitrification of a synthetic secondary-treated sewage effluent. Efficient nitrification occurred for a variety of hydraulic and substrate-nitrogen loadings. Microbiological analyses of the pure oxygen fixed-film reactor indicated that the nitrification process is more dependent upon the activity levels of the nitrifying bacteria than on their absolute densities. Both heterotrophic and nitrifying bacteria were distributed throughout the entire depth of the AMTF without any distinct population profiles. Although pH depression occurred in the lower half of the reactor, nitrifying bacteria densities were not seriously affected. The reactor as constructed is competitive in terms of size and performance with most nitrification systems currently in use.
W81-00120

PROCESS FOR CONCENTRATING TRITIUM AND/OR TRITIUM HYDRIDE AND SEPARATING IT FROM TRITIUM WATER,
Hoechst A.G., Frankfurt am Main (Germany, F.R.).
H. Hesky, and A. Wunderer.
U.S. Patent No 4,190,507, 3 p, 1 Fig, 6 Ref. Official Gazette of the United States Patent Office, Vol 991, No 4, p 1362, February 26, 1980.

Descriptors: *Patents, *Waste water treatment, *Industrial water, *Tritium, Radioactive wastes, Water pollution sources, Electrolysis, Nuclear wastes, Tritium water.

A process for obtaining concentrated tritium and/or tritium hydride and separating it from tritium water is disclosed. In the reprocessing of spent nuclear fuel, the radioactive substance, tritium, in addition to other substances, is released. The tritium so obtained is in the form of tritium water which cannot be recycled and must be stored. Tritium water is intended to include a mixture of water, tritium hydroxide and di-tritiumoxide. Due to the radioactivity of tritium, the tritium water is decomposed into oxyhydrogen gas and tritium steam which must be stored under controlled conditions. By contrast, elemental tritium and/or tritium hydride can be stored without any need for controlled conditions provided that the generated heat is dissipated in a suitable manner. It is therefore, the object of this invention to obtain tritium and tritium hydride in high concentration. This problem is solved by increasing the concentration of tritium hydroxide and di-tritium oxide in the tritium water through distillation and then electrolyzing the enriched mixture. The mixture can be charged to an electrolytic enrichment cascade. The product of electrolysis, i.e., concentrated tritium, is stored and the oxygen is reduced by NO and worked-up to yield nitric acid, which is then used as a solvent in the reprocessing of spent nuclear fuel. (Sinha-OEIS)
W81-00126

PROCESS FOR REMOVING CHALCOPHILE ELEMENTS FROM AQUEOUS SOLUTIONS BY ELECTROLYSIS,
National Research Inst. for Metals, Tokyo (Japan). (Assignee).
H. Kametani, and T. Mitsuma.
No 4, p 1362, February 26, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Industrial water, *Metals, Electrolysis, Separation techniques, Electrochemistry, Sulphides, Chalcophile.

Aqueous solutions containing ions of chalcophile elements are waste waters which occur in the refining and fabricating of metals and in the material industry. To prevent environmental pollution,

these industrial waste waters can be discharged after removing noxious elements, especially heavy metals. The invention provides a process for separating a chalcophile element from an aqueous solution by an electrolytic technique using elemental sulfur as a sulfidizing agent. The process comprises electrolyzing an aqueous solution containing one or more chalcophile elements in the form of ion as a catholyte under acidic conditions in the presence of elemental sulfur powder to precipitate the chalcophile element in the form of sulfide, and separating the precipitated sulfide from the aqueous layer. (Sinha-OEIS)
W81-00127

ELECTROCHEMICAL PROCESS FOR THE REMOVAL OF CONTAMINANTS FROM AQUEOUS MEDIUM,
Eastman Kodak Co., Rochester, NY. (Assignee).
C. M. Chaffin.
U.S. Patent No 4,190,509, 3 p, 8 Ref. Official Gazette of the United States Patent Office, Vol 991, No 4, p 1362-1363, February 26, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Metals, Separation techniques, Industrial wastes, Cooling water, Chromium, Electro-chemistry, Equipment, Regeneration.

Among the most difficult purification problems are those relating to removing small quantities of metallic or anionic radical contaminants from dilute aqueous solutions, such as rinse water from chrome plating operations and purge streams from cooling tower waters that contain hexavalent chromium. Contaminating ions are removed from an aqueous media by an electrochemical method which includes formation of an insoluble iron compound or complex of the contaminant ion utilizing an anode of iron, iron alloy or insoluble iron compound. The hexavalent chromium contaminant, as chromate or dichromate, is changed to trivalent chromium, a less toxic form. Under continuous production operation it has been found that the electrical activity of the cell decreases with time requiring a regeneration of the system. Regeneration of the electrochemical cells can be accomplished without an acid backwash. This improvement consists of modifying the electrochemical cell so as to permit the periodic introduction into the cell of a volume of a compressed gas. Sufficient compressed gas should be provided to provide a thorough agitation throughout the cell. This compressed gas regeneration may be used as a total replacement for acid wash systems or it may be used in conjunction with the acid wash system to reduce the frequency of acid washing. (Sinha-OEIS)
W81-00128

PROCESS FOR BIOLOGICAL PURIFICATION OF WASTE WATER,
Stamicarbon, B. V., Gellen (Netherlands). (Assignee).
B. H. N. Dassen.
U.S. Patent No 4,190,528, 6 p, 2 Fig, 7 Ref. Official Gazette of the United States Patent Office, Vol 991, No 4, p 1368, February 26, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Biological treatment, Hydrolysis, Activated sludge, Temperature, Ammonia.

A process for the biological purification of waste water is described in which a suspension of the surplus sludge formed during the purification is hydrolyzed in a basic medium and at elevated temperatures. The process is carried out by giving the suspension of the sludge a pH value of between about 8 and about 11 and carrying out the hydrolysis in the presence of a volatile base at a temperature of between about 90 and 300 degrees. The base is removed from the hydrolysate formed after the hydrolysis has been terminated. Ammonia or a bound form, such as ammonium carbonate, is used as the volatile base. The ammonia that has been removed from the hydrolysate is returned to the hydrolysis stage. (Sinha-OEIS)
W81-00129

WASTE WATER FILTRATION AND SLUDGE REMOVAL SYSTEM,
Armco, Inc., Middletown, OH. (Assignee).
E. L. Wyatt.
U.S. Patent No 4,190,534, 9 p, 7 Fig. 6 Ref. Official Gazette of the United States Patent Office, Vol 991, No 4, p 1369-1370, February 26, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Industrial wastes, Filtration, Separation techniques, Water reuse, Sludge, Iron, Equipment.

The invention describes a waste water filtration and sludge removal system where the waste water produced by the types of steel treatment processes can be filtered to produce reusable wash water and an iron sludge having an acceptably low water content for convenient handling and possibly for use as a soil conditioner, etc. The system includes a trough-like filtering tank having weep holes along the lower edge draining into an inclined channel for capturing filtered water for reuse, and also includes a multiple layer filter bed containing an upper layer of fine jagged surfaced particles for capturing filtered sludge. The sludge layer deposited on the surface of the upper filter layer is periodically moved by means of an adjustable screed blade toward an elevated discharge station for removal from the tank without significantly disturbing the filter bed. The screed blade may be automatically raised out of contact with the sludge layer when operated in the reverse direction. (Sinha-OEIS)
W81-00132

APPARATUS FOR ON-SITE RENOVATION OF SANITARY WATERS,
F. Besik.
U.S. Patent No 4,190,539, 6 p, 1 Fig, 6 Ref. Official Gazette of the United States Patent Office, Vol 991, No 4, p 1371, February 26, 1980.

Descriptors: *Patents, *Waste water treatment, *Sewage treatment, Water pollution treatment, Domestic wastes, Separation techniques, Oxidation, Chemical precipitation, Equipment.

A self-contained apparatus for on-site renovation of sanitary waters comprises three bioreaction chambers, a mineral storage and dispensing container, a submerged suspended solids separator located in the third bioreaction chamber, a flow equalizer, a chemical oxidizing agent dispensing system, a chemical oxidation-clarification chamber and a charcoal containing chamber, all enclosed in a single tank designed for use as on-site single or multiple family waste water renovation system. (Sinha-OEIS)
W81-00134

WASTE WATER TREATMENT APPARATUS,
Aqua-Aerobic Systems, Inc., Rockford, IL. (Assignee).
T. B. Wade, and J. A. Knight.
U.S. Patent No 4,190,541, 8 p, 6 Fig, 5 Ref. Official Gazette of the United States Patent Office, Vol 991, No 4, p 1372, February 26, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Equipment, Cleaning, Settling basins, Sludge disposal.

A waste water treatment apparatus is described in which a carriage support rail extends across the top of the tank intermediate the side walls of the tank. A carriage is mounted on the rail and is driven by a carriage drive including an endless chain which reciprocates the carriage along the rail. A tank cleaning head is mounted on the carriage for movement along a path adjacent the bottom of the tank. The carriage support rail is in the form of a box-shaped beam having inwardly directed flanges at its underside and the chain is mounted inside the box-shaped beam to be protectively enclosed in the beam. The carriage has wheel mountings extending upwardly into the beam at opposite sides of the chain and carriage support wheels are mounted on the wheel mountings inside the beam and in rolling engagement with the flanges on the beam to support the carriage. The chain has upper and lower runs extending lengthwise of the tank and carries a drive lug. The carriage has an upper and lower follower alternately engaged by the drive lug as it moves respectively along the upper and lower runs of the chain to reciprocate the carriage. (Sinha-OEIS)
W81-00135

WASTE WATER TREATMENT APPARATUS,
J. M. Pederson, and W. J. Beckman, Jr.
U.S. Patent No 4,190,543, 6 p, 5 Fig, 11 Ref; Official Gazette of the United States Patent Office, Vol 991, No 4, p 1373, February 26, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, Sewage treatment, Biological treatment, Flow control, Sludge disposal.

A waste water treatment apparatus and process is especially adapted for tertiary treatment of sewage where biological media panels are positioned in a treatment tank in a manner so that the formation of a stable mat or film composed of solids is established on them. Biological growth on the panels is enhanced while at the same time excessive solids build-up is avoided. Flow through the tank is directed in a generally horizontal fashion and sludge removal is accomplished by pump means. (Sinha-OEIS)
W81-00136

ENERGY SAVING IN ACTIVATED SLUDGE TREATMENT,
Philadelphia Water Dept., PA.
C. F. Guarino, M. D. Nelson, M. Lozanoff, and T. E. Wilson.
Public Works, Vol 111, No 10, p 57-62, 94, October, 1980. 8 Fig, 5 Tab.

Descriptors: *Activated sludge, *Biodegradation, *Aeration, *Pilot plants, Submergence, Suspended solids, Biochemical oxygen demand, Performance, Evaluation, Sewage treatment, Municipal wastes, Waste water treatment.

The upgrading of a Philadelphia waste water treatment plant to provide secondary treatment by a process known as 'Surfact' is described. It was estimated that the Northeast plant conversion to Surfact, which took place in the 1970's, would save $50 million in operating costs over the plant's 20-yr life while reducing energy consumption by 33%. The process combined activated sludge treatment and rotating biological contactors. The objective of this phase of the program was to ascertain the capabilities of an air-driven system, but it was also discovered that microbial growth was increased as compared with mixed liquor solids. A prototype installation was set up in six different modes to provide variations in waste water temperature, effluent BOD, solids retention time, dissolved oxygen, flow rate and air consumption. Modifications were needed in 1978 to provide additional oxygen at a reduced air flow of 6000 cfm. A step feed system was also constructed. Pilot test results for two modes indicated BOD removals of 84% and 95%. As the solids retention time goes past 5, leveling occurs in the amount of removal. A typical effluent suspended solids level at the Northeast plant would be in the range of 110-120 mg/liter. To allow all discs to carry maximum growth levels, a proper combination of mixed liquor flow and loading was necessary. In biological studies, the Surfact adaptations produced an aerobic system with flagellates, swimming ciliates, and stalked ciliates. Settling tests showed that sludge in the prototype settled best at high overflow rates. Optimum disc rotation was 1.5 rev/min. Use of disc solids aided energy conservation. Initial settling velocities of 19 ft/hr were possible. The construction time for upgrading to Surfact was estimated to be minimal. (Geiger-FRC)
W81-00220

INDUSTRIAL TECHNOLOGY ADAPTED TO MUNICIPAL SLUDGE DRYING,
For primary bibliographic entry see Field 5E.
W81-00221

SWEDISH WASTEWATER TECHNOLOGY SETS FAST PACE,
Water and Sewage Works, Vol 127, No 9, p 68, 71-72, 77, September, 1980. 4 Fig, 2 Tab.

Descriptors: *Waste water treatment, *Sweden, *Technology, *Treatment facilities, *Biological treatment, Chemical degradation, Sewage treatment, Biochemical oxygen demand, Nutrient removal, Municipal wastes.

Advancements made over the past 10 yr in Sweden regarding treatment of waste water are reviewed. One of the problems which had faced the Swedish government in 1969 was the level of phosphorus in the water. Biological/chemical plants constructed to meet this challenge are today producing waste waters with at least 98% removal of BOD and phosphorus. Most plants are operating at moderate costs due to success in design engineering and reliability of equipment. Turnkey operations have eliminated fault finding. The contractors assume all responsibilities for the first year of operation and they also train the staff that will eventually take over operations. Specific plants are described that are located at Hoor, Findus, and Malmo. Some other plants are not operated on the turnkey system. Two of these which are described are the plant at Hassleholm, and the one at South Stockholm, Henriksdals. One method currently under study calls for treating sediment to function as an ion exchanger where lime addition is not effective. Novel gasketing systems which have been designed for the Swedish systems are also described. (Baker-FRC)
W81-00223

DESIGN AND ECONOMIC CONSIDERATIONS OF GAC SYSTEMS,
Philadelphia Water Dept., PA.
C. F. Guarino, J. V. Radziul, P. R. Cairo, D. D. Blair, and M. M. Pence.
Water and Sewage Works, Vol 127, No 9, p 58-59, 63-64, 66-67, September, 1980. 4 Fig, 13 Tab, 8 Ref.

Descriptors: *Activated carbon, *Computer models, *Economic efficiency, *Treatment facilities, *Design criteria, *Evaluation, Costs, Capital costs, Operating costs, Maintenance costs, Water treatment, Water purification, Granules, Filtration, Chlorination, Pilot plants, Delaware River.

A flexible computer model was used to evaluate modifications to EPA granular activated-carbon (GAC) design criteria. The cost model was calibrated with data from literature, manufacturer's costs, and information based on GAC facilities in use. Pilot studies were conducted at the Torresdale (Philadelphia) plant where prechlorinated, clarified and filtered water from the Delaware estuary was applied to columns operating at empty bed contact times. Influent and effluent from these columns were analyzed. Major design parameters considered in the economic analysis of GAC post-contactor treatment included various capital items, operation and maintenance costs, and financial items. Major capital costs were the initial carbon, pumping station, contactors, and regeneration facility. Of the operation and maintenance costs, carbon to compensate for the 7% loss was most significant. Analysis of the effects of inflation for various contact times revealed that shorter contact times were more economical with lower rates of inflation. Comparison pilot studies indicated that the proposed EPA design criteria produced a similar bed life for the same contact time in both sand-replacement and post-contactor GAC operations. It is noted that, if a criterion for bed life that is able to discern performance levels between the two systems is developed, the post-contactor system may be more economical than sand replacement. (Baker-FRC)
W81-00224

ION-EXCHANGE BEDS DEFY ORGANIC FOULING,
Belco Pollution Control Corp., Parsippany, NJ.
R. J. Cichon, R. B. Trattner, and P. N. Cheremisinoff.
Water and Sewage Works, Vol 127, No 9, p 48-49, 54, 100, September, 1980. 4 Fig, 4 Tab.

Descriptors: *Ion exchange, *Resins, *Filtration, *Adsorption, *Activated carbon, Organic acids, Fulvic acids, Cation exchange, Anion exchange, Organic wastes, Municipal wastes, Waste water treatment.

The design of ion-exchange beds to withstand organic fouling is described. Field testing is essential because organic matter can consist of such compounds as humic and fulvic acids. The object in ion-exchange is to remove inorganic impurities by demineralizing with simultaneous decolorization by removing anionic color bodies. Various ion-exchange resins were tested with and without activated carbon filtration to determine benefits from ion-exchange as an organic scavenger. The fouling of resins results in poor resin kinetics. Severe fouling results in an increase of dissolved-solids leaking through as flow rate increases and a gradual breakthrough pattern at exhaustion. Six types of mixed beds and streams were tested: isolated, layered, mixed bed; activated carbon and layered, mixed bed; organic trap (S-37) and layered bed; organic trap (A-340) and layered bed; organic trap (IRA-68) and layered, mixed bed; and activated carbon, organic trap (S-37), and layered, mixed bed. The two streams and beds which were most effective were: organic trap (S-37) and layered bed; and activated carbon, organic trap (S-37) and layered mixed bed. Organic matter did not hinder performance of properly structured beds containing ion-exchange resins. (Baker-FRC)
W81-00225

CHEMICALS SUBSTITUTE FOR BIOLOGICAL TREATMENT,
Clark County Sanitation District Las Vegas, NV.
J. H. Parrott.
Water and Sewage Works, Vol 127, No 9, p 36-37, 105-106, September, 1980. 1 Fig, 1 Tab.

Descriptors: *Treatment facilities, *Chemical degradation, *Flocculation, *Sludge treatment, Biochemical oxygen demand, Suspended solids, Trickling filters, Phosphorus, Construction, Separation techniques, Waste water treatment, Waste water disposal, Municipal wastes.

District flow projections in 1975 showed that the Flamingo Road facility of Clark County, Nevada would need a new operation system to handle the rapidly expanding community by 1979. Initial tests indicated that chemical additions would be needed to meet new discharge limitations. The west plant was chosen as the test site over the east plant and its secondary system and trickling filters are described. Energy from the downstream side of the recirculation box leading to a secondary clarifier could be used at the west plant. A 4000 gal pool was erected near the recirculation box and a metering pump was placed at the box and by a manhole 100 ft downstream from the recirculation box. Results showed that high BOD and suspended solids removals were possible. Dosage rates of 100 mg/liter of ferric chloride and 150 mg/liter of alum gave 15 mg/liter BOD, 15 mg/liter suspended solids and 1 mg/liter P or better. After full plant tests, the state agreed to an increase of 36 mgd. A fully automated system was implemented with central monitoring chemical and polymer feed pumps for both the east and west facilities. During full scale operation, the clarity of the secondary clarifiers without chemical additions was poor, but after chemical additions and flocculation, water became quite clear. A consent decree changed the January 1, 1981 discharge limitations to 30 mg/liter BOD, 30 mg/liter suspended solids, and 1 mg/liter P. Preliminary tests show that 10, 10 and 1 mg/liter for BOD, suspended solids and P are attainable, respectively. Projected costs of operation for the new system are $92/million gal of discharge. The only foreseeable problems will be with sludge removal and disposal. (Geiger-FRC)
W81-00227

BIOLOGICAL FLUIDISED BED TREATMENT FOR WATER AND WASTEWATER - A REVIEW OF THE WRC/UMIST CONFERENCE,
Water Pollution Research Lab., Stevenage (England).
P. Cooper.
Water Services, Vol 84, No 1014, p 475-476, 479-480, August, 1980. 3 Fig, 4 Ref.

Descriptors: *Biological treatment, *Biodegradation, *Sands, *Research and development, *Fluid mechanics, Porous media, Conferences, Waste water treatment, Industrial wastes, Sewage treatment, Water treatment, Suspended solids, Potable water, Oxidation, Anaerobic conditions, Engineering, Economics, Particle size, Biological fluidized beds.

This conference was the first conducted on all aspects of biological fluidized bed (BFB) water treatment. Papers discussed the basic principles of BFBs, the use of BFBs in the treatment of potable water, of sewage, and of industrial effluents, the treatment of settled sewage by anaerobic BFB systems, the process engineering of BFBs and the pilot-plant experiences of two companies that will soon be selling BFB systems, and the economics of BFBs compared with activated sludge systems. The first reported work on the performance of BFBs under diurnal-flow and variable-load conditions was presented, and it was concluded that a carefully designed plant could overcome these problems. A unique two-phase system in which air was used as the oxygen source was described. Several conclusions were drawn. Sand was the most widely used solid medium for two-phase systems. The cost of oxygen is a major problem in the United Kingdom but not in the USA; anaerobic treatment may prove more feasible. More information on media/biomass separation and BFB performance under nitrifying conditions is required. The start-up of reactors is not such a major problem as was previously thought. A liquid distribution system described at the conference may be suitable for full-scale plants. The implementation of full-scale plants is still needed. (Gish-FRC)
W81-00238

CLEANER TYNE.
Water Services, Vol 84, No 1014, p 467-469, 471-472, August, 1980. 12 Fig.

Descriptors: *Sewerage, *Interceptor sewers, *Settling basins, *Telemetry, *Treatment facilities, Sewage treatment, Sewers, Water pollution, Waste water treatment, Rivers, Sewage disposal, Screens, Sludge disposal, Instrumentation, Aeration, Planning, Municipal wastes, Control systems.

The 107-million pound Tyneside Sewerage Scheme to reduce pollution in England's River Tyne is described. The project, which is more than 60% complete, involves the construction of interceptor sewers running parallel to the river and coastline which will intercept > 100 existing discharges to convey the sewage to the Howdon Sewage Treatment Works (HSTW). Sewage from the river's south bank will flow to the Preliminary Treatment Works at Jarrow (JPTW) on the south bank, where it will be directed under the river to the HSTW. Sewage from the north bank will flow directly to HSTW. The total length of the sewers will be approximately 75 km. JPTW incorporated coarse bar screens followed by fine bar screens, a Geiger press, and aerated spiral flow grit channels to remove grit particles > or = 0.2 mm in diameter. HSTW is designed for a future population of one million and in the first stage will provide for the removal of screenings and grit followed by sedimentation. There are 12 sedimentation tanks, each with a capacity of 7,400 cu m. A computer with telemetry equipment provides communication between HSTW and 118 outstations at remote plant centers, pumping stations, treatment works, and flow measurement stations. Sludge collected at HSTW will be transported by a sea-going vessel (capacity: 1,500 tons sludge, 50 tons grit) for dumping at sea. Sufficient land exists for a secondary treatment plant to be built at Howdon if necessary. (Gish-FRC)
W81-00239

FOOD PROCESSING WASTES MANAGEMENT,

Russell Research Center, Athens, GA.
W. K. Whitehead.
Agricultural Engineering, Vol 61, No 8, p 26-27, August, 1980. 3 Fig.

Descriptors: *Food processing industry, *Waste water treatment, *Waste water reclamation, Industrial wastes, Aerobic treatment, Irrigation, Lagkoons, Land treatment, Biochemical oxygen demand, Water conservation, Water reuse, Pretreatment(Water), Sewage treatment, Organic wastes, Water pollution sources.

Methods for conservation and efficient use of water by food-processing plants are identified. Waste water, the most difficult byproduct of food-processing operations to dispose of, can be partially reclaimed in caning operations, which can reduce water use by 30%, as well as almost eliminate the need for water softeners and lower water heating requirements. Ways in which food processing plants control pollution are inhouse control (including water conservation) and pretreatment or full treatment prior to discharge. Secondary treatment appropriate in rural areas include aerobic lagoons, which have a sporadic performance, and land application, which is not yet in common practice. All reduce organic loading to streams. The choice of method is a function of plant location and economic factors including costs related to waste management regulations. (Titus-FRC)
W81-00241

ONSITE WASTEWATER TREATMENT FOR A RECREATION AREA,
ADI Ltd., Fredericton (New Brunswick).
T. Viraraghaven, R. C. Landine, and G. H. Jenkins.
Public Works, Vol III, No 10, p 63-64, October, 1980. 1 Fig.

Descriptors: *Recreation facilities, *Septic tanks, *Tile drainage, *Domestic wastes, Waste water treatment, Sanitary engineering, Sewers, Tile drains, Sumps, Waste water disposal.

A system was designed to handle waste water treatment at the Cavendish Beach recreation area on Prince Edward Island National Park. The system was to handle 13,200 Imperial gallons (Igal) per day with the flow being generated over a period of 8 hrs. Various onsite treatment alternatives were considered including package or other mechanical treatment plants with a surface discharge of effluent, two-cell stabilization pond with surface discharge of effluent, spray irrigation, or septic tank-tile field system. The fourth choice was the one installed. The 400-foot 8-inch gravity sewer running from the changehouse/concession facility to the septic tank has a maximum flow of 66 Igpm. The septic tank capacity is 14,000 Igal in two compartments with minimum volume being equivalent to the daily flow. Sump capacity is 1,250 Igal, 75% of the volumetric capacity of tile in one field. Soil in the three tile beds consisted of sandy silt with relatively low permeability. The system has a rest period of 8 months a year and 12 to 16 hr during the daily operation in the summer. (Baker-FRC)
W81-00242

FEEDING OF PRESSURE FILTERS,
Effluent and Water Treatment Journal, Vol 20, No 8, p 399-401, August, 1980. 4 Fig.

Descriptors: *Filters, *Pressure, *Flow, Mechanical properties, *Sludge treatment, Dewatering, Separation techniques, Bulk density, Pumps, Treatment facilities, Filtration, Flow resistance, Waste water treatment.

The designing of feed systems to serve pressure filters is discussed. Feed requirements for a filter designed to serve and operate under a given set of conditions are highly predictable. These requirements are related to the size of the filter, the dry solids level of the cake to be produced, the density of the individual sludge particles, the length of the filtration cycle, and the concentration of the conditioned sludge to be supplied to the filter. Pilot testing will provide the needed information. During initial operation, the mechanical design of the filter and its piping will determine the resistance to the flow through the filter. However, soon the permeability characteristics of the conditioned sludge will become the dominant influence and the flow to the end of the cycle will be greatly influenced by that permeability. An example is given in which a Willett model 12/150/34/B is used to feed a filter. (Baker-FRC)
W81-00248

DISC DIFFUSERS,
Effluent and Water Treatment Journal, Vol 20, No 8, p 393, 395, August, 1980. 2 Fig, 1 Tab.

Descriptors: *Aeration, *Diffusion, *Bubbles, *Sludge treatment, *Pores, Disc diffusers, Porosity, Injection, Air circulation, Activated sludge, Testing, Oxygenation, Ozone, Waste water treatment.

The Degremont DP203 porous ceramic diffuser is a 230-mm diameter disc, 19 mm in thickness and composed of a blend of corundum grains bonded together using ceramics. The disc is used for the diffusion of clean oil-free gases into liquids, and for aeration of activated sludge where low noise levels, flexibility of operation, ease of maintenance and high oxygenation are important. It may also be applied to obtain optimum contact conditions for ozonization of potable water, industrial effluents, and sewage. The new disc with flat surface is compared with the earlier dome diffuser. The disc provides 60% more surface area than the dome and has perpendicular edges that provide greater oxygenation capacity. It can support a vertical load of 400 kg and diffuse clean, oil-free air into the liquid in a column of bubbles 2 to 3 mm in average diameter at a height of 50 mm above the surface of the disc. Tests carried out by the Water Research Centre and Degremont to assess disc performance showed that at a depth of 4 m and a flow rate of 3.3 cu mm/hr/disc, the oxygenation efficiencies in clean water ranged from 5.41 to 5.56 kg oxygen/kwh. In a larger tank, slightly poorer oxygenation efficiencies were observed. Experiments comparing discs and domes providing the same surface area under identical operating conditions resulted on the average in a 10% higher oxygenation efficiency when the discs were used. (Geiger-FRC)
W81-00250

5E. Ultimate Disposal Of Wastes

INDUSTRIAL TECHNOLOGY ADAPTED TO MUNICIPAL SLUDGE DRYING,
Public Works, Vol 111, No 10, p 51-53, October, 1980. 4 Fig.

Descriptors: *Treatment facilities, *Incineration, *Sludge disposal, *Solid wastes, Dewatering, Oxygenation, Coagulation, Steam, Cryogenics, Drying, Waste water treatment, Sludge treatment.

The implementation of municipal sludge drying is part of a $27.5 million waste water treatment project in Harrisburg, Pennsylvania. The city's improved and expanded facility is an energy recovery system which will upgrade the sewage treatment and water quality, help provide a solution to solid waste and sludge disposal problems, and generate more than a million dollars per year through the use and sale of steam for district heating and recycled metal. Design considerations included a 65-mgd settled sewage pumping station, three four-stage oxygenation tanks, cryogenic oxygen generating equipment, two flash mixing tanks to add alum, six rapid sludge removal final settling tanks, a return sludge pumping station, two gravity thickeners, one new chlorine contact tank, and two sludge digesters. Currently the incinerator does not fall under the stipulations of the Federal Air Quality Act. However, state standards are being met or exceeded by the use of electrostatic precipitators. At full capacity the incinerator will process 720 tons/day of solid waste and 35 tons/day of sludge, resulting in a residue of 7% of the original volume. (Baker-FRC)
W81-00221

FLUID BED INCINERATION,
R. J. Sneyd, and D. T. Mayrose.
Water and Sewage Works, Vol 127, No 9, p 38-40, 44-45, September, 1980. 7 Fig, 6 Tab.

Descriptors: *Sludge disposal, *Incineration, *Heat exchangers, *Ultimate disposal, Sludge treatment, Drying, Mechanical enginering, Dewatering, Separation techniques, Treatment facilities.

Use of fluid bed incineration in the design of the West German Marienfeld sewage treatment plant and other such plants under construction in North America is reviewed. A fluid-bed reactor consists of three basic sections. The upper is the area for disengagement of the bed material from the upmoving air stream. The fluidized bed boils rapidly, providing the extreme mixing which is important for good combustion. Feeding sewage sludge into the fluidized mass is normally accomplished with either screw feeders or positive displacement pumps. Complete combustion of the sewage sludge takes place within the bed in less than one minute with only 40% excess air. Early fluid-bed incineration systems made use of the cold-windbox design. This design is discussed and compared with the hot windbox concept which is essentially similar except for the addition of a heat exchanger. Various types of gas scrubbers may be employed. With vacuum filters or centrifuges, cakes of sludge with a primary-to-secondary sludge ratio of at least 50% are sent to incineration with 18-22% dry solids. Various advantages of using fluidized beds are detailed. Environmental compatibility and size selection are considered. (Baker-FRC)
W81-00226

LONG SEA OUTFALL UNDER CHESIL BEACH.
Water Services, Vol 84, No 1014, p 540-541, August, 1980. 3 Fig.

Descriptors: *Outfall sewers, *Pipelines, *Pipe flow, *Sewage disposal, *Sites, Oceans, Ultimate disposal, Sewerage, Treatment facilities, Discharge lines, Construction, Pumping, Waste water treatment, Municipal wastes, Waste water disposal.

The remodeling of the Weymouth, Portland, and Wyke Regis sewage disposal facilities in England was carried out in the late 1970's. The sea discharge of both outfalls was just 300 m off the harbor mouth, a distance considered too short by modern standards. A study of inland treatment options which examined seven sites uncovered one site at Wyke Castle as a suitable place to begin tunneling. The discharge from this point would be 400 m offshore from Chesil Beach, however expenses for the plan were too high. Offshore and onshore studies up to the design stage were carried out and it was decided that all existing outfalls with flows intercepted and sent to Wyke Regis would be eliminated. The new outfall at Weymouth will be 2.7 km long and 1.68 m in diameter. It will have 10 diffusers at 4.5 m intervals each with twin 250 diameter jets. Incoming solids will be reduced to under 5 mm diameter by the headworks and screenings will be stored until removal by tanker. Most of the headworks housing will be underground so that it will not be visible to nearby residents. Outfall flow will be by gravity and it was reported to be 415 m out at the author's last visit to the facility. Water from an aquifer was found in the shaft and tunnel, but this was remedied by pumping. Further reports on the project covering the outfall and headworks are expected. (Geiger-FRC)
W81-00231

FEEDING OF PRESSURE FILTERS,
For primary bibliographic entry see Field 5D.
W81-00248

DIRECT POLYMER INJECTION,
Effluent and Water Treatment Journal, Vol 20, No 8, p 397, August, 1980. 1 Fig.

Descriptors: *Sludge treatment, *Dewatering, *Polymers, *Injection, *Ultimate disposal, Polyelectrolytes, Treatment facilities, Municipal wastes,

Pumps, Mechanical engineering. Mechanical equipment, Compaction, Compressibility.

The use of polyelectrolytes for the dewatering of sludge in filter presses is rapidly replacing other conventional chemicals. Composting is also being used in many countries with the aid of polyelectrolytes. Early attempts at sludge injection with polyelectrolytes were unsuccessful due to the use of costly separate metering pumps. On a two pump system operating on the same principle as the Willett ram pump, sludge could be sucked in on one pump while the auxillary pump was on the delivery stroke. This pumping unit allowed for adjustments to compensate for day-to-day changes in the rate of dose to dry solids. The system calls for no extra electrical control equipment and may be easily installed to existing systems. The output of filter presses can be increased by improvements in polymer stability and application methods. Results so far from municipal and industrial installations in the United Kingdom on such systems show that improved throughput has been achieved through reduced cycle times. Pre-fill pumps with closed discharge on the bottom filtrate outlets are recommended for new installations. Better moisture distributions and reduced risk of blockages are avoided by prefilling the presses with final effluent to prevent pre-filtration within the press. (Geiger-FRC)
W81-00249

5F. Water Treatment and Quality Alteration

PRODUCTION, FATE AND REMOVAL OF TRIHALOMETHANES IN MUNICIPAL DRINKING WATER SYSTEMS,
Tennessee Univ., Knoxville.
R. A. Minear.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-112443, Price codes: A12 in paper copy, A01 in microfiche. Water Resources Research Center, University of Tennessee, Research Report No 78, April 1980. 253 p, 39 Fig, 44 Tab, 69 Ref, 8 Append. OWRT-A-051-TENN (1), 14-34-0001-0145.

Descriptors: *Trihalomethanes, *Chloroform, Dichloromonobromomethane, Dibromomonochloromethane, Bromoform, Bromide, Humic Acids, *Gas chromatography, *Potable water, *Municipal water, Water treatment.

A two phase project has been conducted that began with a survey of 33 Tennessee drinking water supplies in which the levels of trihalomethanes in the finished water were assayed quarterly for one year. Summer concentrations were found to be much higher than for the other seasons with just less than half of the supplies exceeding 100 mg THM per liter. Only four systems averaged in excess of 100 mg/l for the four quarters and three others were just under this value. Surface raw water sources represented all high THM values while spring and well water sources were typically very low in THM content. NVTOC was found to be strongly related to the THM levels. When THM values were higher, chloroform was the dominant species, however, in a number of systems, bromine containing species were high and frequently the dominant forms. The second phase of the project was an outgrowth of attempts to decipher the variable species distribution. The results indicated that bromide can be an important factor in THM formation.
W81-00011

THE INFLUENCE OF FULVIC ACID ON CU2+, CD2+ AND ZN2+ REMOVAL FROM DRINKING WATER BY ALUM COAGULATION AND CU2+ AND CD2+ COMPLEXING CAPACITY MEASUREMENTS OF FULVIC ACID AND NATURAL FRESHWATER SAMPLES BY DIALYSIS TITRATION,
New Hampshire Univ., Durham. Dept. of Chemistry.
R. E. Truitt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-111262, Price codes: A09 in paper copy, A01 in michrofiche. PhD Dissertation, 1980. 163 p, 27 Fig, 16 Tab, 133 Ref, 1 Append. OWRT B-004-NH (3), 14-34-0001-8132.

Descriptors: *Water treatment, *Dialysis, *Fulvic acid, Metals, Humics, *Heavy metals, Copper, Cadmium, Zinc, Drinking water, Separation techniques, *Statistical experimental design, Metal ion binding, Complexing capacity, Dialysis titration, Alum coagulation.

Two studies of metal ion complexation by humic material were conducted. In the first, Cu super 2+, Cd super 2+ and Zn super 2+ removal from solution during alum coagulation treatment was measured in the presence and absence of soil-derived fulvic acid (SFA). In a statistically designed experiment, it was found that 6-96% Cu super 2+, -6 to 59% Cd super 2+, and -7 to 82% Zu super 2+ losses were effected. The significant variables were ph, alum dosage, and an interaction effect of SFA level with both ph and alum dosage. In the second study, a dialysis titration technique for the measurement of natural water Cu super 2+ and Cd super 2+ complexing capacity was critically evaluated. Complexing capacities of 6.25 M EDTA, 15.5 M SFA, and 7 freshwater samples were measure. No more than 10% of the SFA binding material permeates the dialysis membrane. Correlation of several water properties reveals that only the Cu super 2+ titration results correlate with ph, alkalinity, hardners and conductance. Color and D0C do not correlate with any water property.
W81-00027

OPTIMUM ALUM DOSE SELECTION FOR THE DURHAM WATER TREATMENT PLANT,
New Hampshire Univ., Durham. Dept. of Civil Engineering.
W. J. Gallot.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-110348, Price codes: A07 in paper copy, A01 in microfiche. Master of Science Thesis, 1980. 136 p, 41 Fig, 14 Tab, 40 Ref, 9 Append. OWRT B-005-NH (2), 14-34-0001-9122.

Descriptors: *Fulvic acid, *Water treatment, Water quality, *Turbidity, *Potable water, New Hampshire, Drinking water, Coagulation, Flocculation, Sedimentation, *Alum, *Color removal, Linear regression equations, Humic substances, Organic color, Raw water quality, Fulvic acid concentration, Absorbance, Aluminum concentration, Suspended material, *Durham(NH).

The purpose was to determine the relationship between the raw water quality and the optimum alum dose for a color removal process. Jar tests were performed on water samples collected at the Durham Water Treatment Plant reservoir. The residual apparent color, apparent fulvic acid concentration, turbidity, absorbance and aluminum concentration were measured. Glass fiber filters were used to simulate the filtration step of the treatment process. A methodology was developed for the selection of the optimum alum dose. The methodology took into account chemical costs, operation costs and the regulatory guidelines and standards for color and turbidity removal. In the majority of the jar test results, the optimum alum dose selection was controlled by color removal. That is when the residual color was minimized the optimum alum dose had been reached. In the remaining jar tests, turbidity removal controlled the optimum alum dose selection. In order to utilize these results in an optimum control strategy, linear regression equations were estimated for the selection of alum dose as a function of the raw water quality. In addition, since ph adjustment is important for optimal performance of the color and turbidity removal process, regression equations for phcontrol were also developed. The effects of temperature upon the control strategy are discussed. Since an automatic control scheme is perceived, the raw water absorbance was used as a surrogate measure of the raw water color. The application of these equations to practical plant operations are discussed.
W81-00028

INFLUENCE OF PH ON DOSAGE REQUIREMENTS OF FERRIC CHLORIDE,
North Carolina State Univ. at Raleigh. Dept. of Civil Engineering.
E. P. Galarraga.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-110355, Price codes: A04 in paper copy, A01 in microfiche. MS Thesis, 1980. 55 p, 17 Fig. OWRT-A-108-NC (1), 14-34-0001-9035.

Descriptors: *Coagulants, *Water supply, *Water treatment, *Hydrogen ion concentration, Chemical precipitation, Ferric chloride, Turbidity removal.

This study investigates the feasibility of reducing the dosage requirement of ferric chloride for the removal of colloidal particles from waters containing low alkalinity by manipulating the pH control of the coagulation process. When metallic salts such as ferric chloride are used as coagulants, the solution pH needs to be maintained at an optimum level to allow the formation of hydroxopolymers or hydroxide precipitates from the added coagulants. Since the chemical reactions result in reduction the solution pH, bases are simultaneously added to maintain a constant pH at the optimum level. The results of laboratory studies indicate that a two-step pH control method can achieve the same removal efficiency as the constant pH method, but at lower dosage requirements. The new two-step pH control technique investigated allows the solution pH to drop to lower levels (e.g. 3.5) during the addition of ferric chloride. It is then adjusted back to the optimum level with the addition of bases. Savings of 15-52% ferric chloride can be obtained, depending on the initial solids concentrations. If the water to be treated contains high suspended solids but low alkalinity, the optimum dosage level of ferric chloride required will be sufficient to reduce the water pH to the desired low levels (e.g. 3-4). Thus, savings of ferric chloride can be achieved simply by delaying the addition of bases required for pH adjustment.
W81-00029

THE CHARACTERIZATION OF FULVIC ACID FRACTIONATED BY GEL PERMEATION CHROMATOGRAPHY,
New Hampshire Univ., Durham. Dept. of Civil Engineering.
R. Bixby.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-113896, Price codes: A06 in paper copy, A01 in microfiche. Master of Science Thesis, 1979. 91 p, 14 Fig, 13 Tab, 59 Ref, 5 Append. OWRT-A-048-NH (2), 14-34-0001-8031.

Descriptors: *Fulvic acids, *Water treatment, *Chemical analysis, *Chromatography, Spectroscopy, Coagulation, *Humic substances, *Chlorinated organics, Gel permeation chromatography, Trihalomethanes, Aluminum sulfate, Chemical structure, Infrared spectroscopy, Ultraviolet spectroscopy, Nuclear magnetic resonance spectroscopy, Hypochlorous acid.

Fulvic acid, the major component of naturally occurring humic substances in water, is both a precursor of chlorinated organics in drinking water and the source of organic color in surface waters. The purpose of this study was to isolate and characterize components of fulvic acid, and relate these findings to water treatment practices for the removal of color, primarily coagulation with aluminum sulfate. Fulvic acid was fractionated into four fractions by gel permeation chromatography. Chemical characterization of each fraction included carbon, hydrogen, nitrogen, water, and ash analyses. The structures of the fulvic acid fractions were elucidated by the use of infrared, ultraviolet, and nuclear magnetic resonance spectroscopy. An aluminum binding study was performed to gain insight into the mechanism of fulvic acid removal during coagulation. The fractions were isolated and found to be discrete components of fulvic acid with different chemical and structural characteristics. Test results indicated that the smallest molecular weight fraction was the most homogeneous, being primarily an aromatic substituted with carboxylate functional groups, and was able to com-

plex more aluminum than any other fraction. It was concluded that fulvic acid cannot be completely nor selectively removed during coagulation with aluminum sulfate, and thus, trihalomethanes will always be produced during disinfection with hypochlorous acid.
W81-00031

MIXED-FORM POLYHALIDE RESINS FOR DISINFECTING WATER,
Aqua-Chem, Inc., Milwaukee, WI. (Assignee).
G. L. Hatch.
U.S. Patent No 4,190,529, 4 p, 4 Tab, 7 Ref. Official Gazette of the United States Patent Office, Vol 991, No 4, p 1368, February 26, 1980.

Descriptors: *Patents, *Water treatment, *Disinfection, Water purification, Bactericides, Anion exchange.

The invention relates generally to the art of water disinfecting and in particular to the use of a bactericidal mixed-form polyhalide resin. A strongly basic anion-exchange resin loaded with iodine and a less than stoichiometric amount of an iodide salt or bromine and a less than stoichiometric amount of bromide sale is an effective demand bactericide for disinfecting water. The bactericidal resin elutes only small amounts of halide ions and is especially suited for killing bacteria in feed water supplies having relatively high salt content. (Sinha-OEIS)
W81-00130

AN AQUATIC FUNGUS FOR BIOLOGICAL CONTROL OF MOSQUITO LARVAE,
Clemson Univ., SC. Water Resources Research Inst.
C. J. Umphlett.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-119307, Price codes: A03 in paper copy, A01 in microfiche. Report No 79, November, 1979. 44 p, 40 Fig, 54 Ref. OWRT-A-031-SC(1).

Descriptors: *Aquatic fungi, *Biocontrol, *Pest control, *Insect control, *Mosquitoes, *Treatment facilities, Freshwater fungi, Fungi, Aquatic life, Aquatic microorganisms, Water pollution sources, Microbiology, Aquatic insects, Testing, Testing procedures, Larvae, Insect eggs, Larvae growth stage, On-site tests, Mortality.

This study sought to evaluate the use of a low level dose of an aquatic fungus, Lagenidium giganteum (LG), for the control of larvae of the Culex pipiens quinquefasciatus (CPQ) mosquito. While the overall project commenced in 1973 with construction completion of an outdoor screened-in test facility in 1974, and establishment of a CPQ colony in 1975, the present report presented information on data collected in the Spring, Summer, and Fall of 1976. Egg counting, pH, air/water temperatures, relative humidity, and fungal introduction were all controlled by the study protocol. Three weeks after inoculation of new CPQ mosquito pools with LG fungus, the adult population had been dramatically reduced in the test chambers. The larvae and pupae were carefully screened to insure that competing parasites were absent. It was concluded that LG can be a significant force against culicine mosquitos when applied and managed properly. Serious consideration for a research program was recommended, including large-scale field testing, which would include development of a type of inoculum and a delivery system suited to large-scale operations. Field testing must be done for the good prognosis observed for LG for population management of selected mosquitoes species to be realized. (Zielinski-IPA)
W81-00198

INACTIVATION OF COXSACKIEVIRUSES B3 AND B5 IN WATER BY CHLORINE,
North Carolina Univ. at Chapel Hill. Dept. of Bacteriology.
H. Jensen, K. Thomas, and D. G. Sharp.
Applied and Environmental Microbiology, Vol 40, No 3, p 633-640, September, 1980. 11 Fig, 1 Tab, 19 Ref.

Descriptors: *Chlorination, *Viruses, *Disinfection, *Chlorine, Sodium chloride, Potassium compounds, Cesium, Water purification, Analytical techniques, Water treatment.

The effects of chlorine disinfection of water on coxsackieviruses B3 (CB3) and B5 (CB5) were evaluated by exposing virus preparations to chlorine solutions in a continuous flow apparatus. Virus inactivation by chlorine in dilute buffer at pH 6 was very similar for CB3 and CB5; the inactivation rate was about half that for poliovirus (Mahoney) under similar conditions. Purified CB3 aggregated in the acid range but not at pH 7 or above, while purified CB5 aggregated in all pH ranges. The log surviving infectivity was graphically plotted as a function of time and resulted in a straight line. Dispersed CB5 provided no chlorine inactivation data because the virus could only be dispersed by diethylaminoethyl dextran, which reacts with chlorine. The aggregation of CB5 or the rate of chlorine action on the viruses was unaffected by the addition of 0.1 M NaCl to the buffer at pH 6. At pH 10, NaCl increased the disinfection activity of OCl(-) by a factor of 20 for both viruses; the addition of cesium chloride had a similar but lesser effect. The addition of KCl had the most rapid inactivation effect of the reagents. The inactivation effects of OCl(-) at pH 10 were equal to those of HOCl at pH 6 in the presence of KCl. (Lisk-FRC)
W81-00216

DESTRATIFICATION OF RESERVOIRS-A DESIGN APPROACH FOR PERFORATED-PIPE COMPRESSED-AIR SYSTEMS,
Water Research Centre, Marlow (England). Medmenham Lab.
J. M. Davis.
Water Services, Vol 84, No 1014, p 497-498, 501-504, August, 1980. 9 Fig, 1 Tab, 9 Ref.

Descriptors: *Reservoir storage, *Destratification, *Mixing, *Dissolved oxygen, Design, Aeration, Thermal stratification, Epilimnion, Hypolimnion, Water circulation, Thermocline, Bubbles, Water quality control, Water storage.

Artificial mixing devices should prevent thermal stratification and increase dissolved oxygen levels throughout the water column. The perforated-pipe compressed air device is being increasingly used to improve reservoir oxygen content. A summary is presented of the Water Research Centre's experience with perforated pipe systems and useful information is offered to determine the length of perforated pipe and compressor size needed for a particular reservoir. In thermal stratification, the thermocline forms a barrier between the epilimnion and hypolimnion isolating the lower layers of the reservoir from the air at the surface. A typical perforated pipe system in the UK involves a 200-m long pipe closed at one end with small holes which is submerged into the reservoir. Compressed air is pumped through the pipe and the air bubbles released entrain water from the lower levels and carry it to the surface. To apply the mathematical data for the determination of piping needed for a particular reservoir, volume, temperature profile, energy requirements and pressure conditions must be known. Other considerations included are pipe selection, total air flow, anchor weights and costs for equipment and operation of the destratification system. (Geiger-FRC)
W81-00235

5G. Water Quality Control

METHOD OF EFFECTING FLOCCULATION,
Kewanee Industries, Inc., Bryn Mawr, PA. (Assignee).
H. A. Green, J. J. Merianos, and A. N. Petrocci.
U.S. Patent No 4,188,293, 3 p, 6 Ref; Official Gazette of the United States Patent Office, Vol 991, No 2, p 620-621, February 12, 1980.

Descriptors: *Patents, *Water treatment, Water quality control, *Flocculation, Surfactants, Emulsions, Chemical reactions, Industrial water.

Another use for the compounds of this invention, or mixtures of such compounds, is for flocculation in aqueous systems. As flocculants, they cause the sedimentation of some materials which might otherwise remain in aqueous suspension; or, at least, they increase the rate of sedimentation in many cases where continued suspension of such immiscible materials cause a problem when it is desired to clarify and draw off the clear supernatant aqueous solutions or when it is desired to filter or drain suspensions in industries that require large volumes of water. The compounds also may be used to clarify waters in which the pollutants are emulsified. In such cases, the compounds may cause the emulsion to break. (Sinha-OEIS)
W81-00123

ROTARY FILTER APPARATUS,
T. Hagihara.
U.S. Patent No 4,188,294, 11 p, 24 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 991, No 2, p 621, February 12, 1980.

Descriptors: *Patents, *Water quality control, *Water pollution treatment, Filtration, Filters, Equipment, Channels, Running water.

A rotary filter apparatus is installed in a water channel in order to arrest, transport and dump the solids in the water currents while reconditioning the filter meshes for continuous operation. The apparatus includes an endless belt composed of many linking rods, linking plates, wire ropes or screen plates, and specially-shaped filter plates rockably fitted on the linking rods. The filter belt travels through the frame that can differentiate the track from the track of the filter plates. (Sinha-OEIS)
W81-00124

METHOD OF CONCENTRATING AND COLLECTING OIL SPILLS,
CIBA-GEIGY Corp., Ardsley, NY. (Assignee).
R. A. Falk.
U.S. Patent No 4,190,531, 9 p, 5 Tab, 3 Ref. Official Gazette of the United States Patent Office, Vol 991, No 4, p 1369, February 26, 1980.

Descriptors: *Patents, *Oil pollution, *Oil spills, *Water quality control, Oil-water interfaces, Films, Surface tension, Chemical reactions, Surface active agents, Fluorochemicals.

Oil spills can be more effectively concentrated, collected, and controlled by employing a durable, rapidly spreading, water-insoluble surface film comprised of a fluorochemical. The fluorochemical agent has a density greater than water, a solubility of less than 0.01% in water, a spreading pressure, and is applied with a diluent to form a highly mobile film under actual field conditions. Useful fluorochemicals are especially effective under adverse environmental conditions, and in combination with mechanical cleanup devices. (Sinha-OEIS)
W81-00131

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

EVALUATION OF STOCHASTIC STREAMFLOW MODELS FOR DETERMINATION OF MUNICIPAL WATER SUPPLY RELIABILITY,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-112427, Price codes: A05 in paper copy, A01 in microfiche. Center for Environmental Research, Cornell Univ., Research Project Technical Completion Report September, 1980, 86 p. 7 Fig, 2 Append. OWRT-A-085-NY (3), 14-34-0001-8034, 14-34-0001-0934.

Descriptors: *Synthetic hydrology, *Simulation analysis, Reliability, *Reservoir yield, Lognormal distribution, Correlations, Parameter uncertainty,

Upper Delaware River Basin, *Water supply, Municipal water.

This final report summarizes work performed to compare and evaluate the efficiency of alternative estimators of the parameters of 2- and 3-parameter lognormal distributions and the correlation among lognormal random variables. Also discussed is work performed on stochastic streamflow model verification and validation and the effects of parameter uncertainty on derived distributions. Appendices include the papers 'Synthetic Streamflow Generation, Part I: Model Verification and Validation' and 'Synthetic Streamflow Generation, Part II: Effect of Parameter Uncertainty', by J. R. Stedinger and M. R. Taylor.
W81-00012

THE APPLICATION OF PROJECT ANALYSIS TO NATURAL RESOURCE DECISIONS,
Minnesota Univ., St. Paul. Dept. of Agricultural and Applied Economics.
K. W. Easter, and J. J. Waelti.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-112658, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center, University of Minnesota, St. Paul, Bulletin Number 103, June 1980. 181 p. OWRT-A-999-MINN (50).

Descriptors: *Project planning, *Project analysis, *Project evaluation, *Cost-benefit analysis, Economics, Cost allocation, Irrigation, Navigation, Flood control, Recreation and environmental resources, Uncertainty, Externalities, *Water resources development.

This publication is intended to serve as a guide for the application of water project planning and analysis. Included are a perspective from which to review economic decisions; a brief history of evaluation procedures for U.S. water projects; a description of the Water Resources Council's procedures; the basic economics of project evaluation; problems in cost allocation; and individual applications to irrigation, flood control, navigation and related transportation, and recreation and environmental resources. Emphasis is placed on social benefits measured in terms of additions to real product and savings in terms of real resources.
W81-00023

HYDRAULIC DESIGN OF BRIDGES WITH RISK ANALYSIS,
Geological Survey, NSTL Station, MS. Water Resources Div.
For primary bibliographic entry see Field 8A.
W81-00054

PLAN OF STUDY FOR THE NORTHERN ATLANTIC COASTAL PLAIN REGIONAL AQUIFER SYSTEM ANALYSIS,
Geological Survey, Trenton, NJ. Water Resources Div.
H. Meisler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-201023, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-16, April 1980. 27 p, 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Aquifer management, *Project planning, *Regional analysis, *Atlantic Coastal Plain, *Aquifer characteristics, Groundwater, Pumping, Drawdown, Water levels, Geochemistry, Hydrogeology, Water supply, Forecasting, Model studies, Delaware, Maryland, New Jersey, New York, North Carolina, Virginia, Cones of depression.

Sediments of Cretaceous to Holocene age compose the Northern Atlantic Coastal Plain aquifer system in an area of 50,000 square miles in parts of New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina. The aquifer system is a major source of water supply in the area. About 1.4 billion gallons is withdrawn from its aquifers each day. Increasing withdrawal of ground water has created or intensified several problems such as declining water levels, development of large cones of depression, saltwater intrusion, spreading of ground-water contamination, and land subsidence. The U.S. Geological Survey has begun a comprehensive study that will define the geology, hydrology, and geochemistry of the aquifer system. The effects of future utilization of the aquifer system will be determined and alternative plans for water withdrawal will be evaluated through computer simulation modeling. This report describes the objectives, organization, and work plans of the study. (USGS)
W81-00068

DESIGN STUDY OF THE VTE BOILER CYCLE FOR THE DESALINATION OF SEA WATER VOLUME 1. MAIN REPORT AND APPENDIX A,
Envirogenics Systems Co., El Monte, CA.
For primary bibliographic entry see Field 3A.
W81-00071

TECHNOLOGY FORECASTING IN WATER RESOURCE PLANNING,
Iowa State Univ., Ames. Dept. of Industrial Engineering.
R. Viathionathan, R. Berger, and T. A. Austin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-115669, Price codes: A07 in paper copy, A01 in microfiche. Iowa State Water Resources Research Institute, Iowa State University Completion Report, July 1980. 133 p, 14 Fig, 9 Tab, 55 Ref, 6 Append. OWRT-A-057-IA(2), 14-31-0001-5015.

Descriptors: *Forecasting, *Mathematical models, *Water distribution(Applied), *Technology, *Water resources planning, Methodology, Prediction, Future planning(Projects), Planning, Projections, Risks, Computer models, Iowa, Water resources, Irrigation, Consumptive use, Water resources development, Industry, Agriculture, Farming.

This report was a completion report for a three-year research project on technological forecasting methodologies in water resource planning, conducted in three phases: (1) investigation of various types of forecasting methodologies and development of an overall forecasting/planning system (containing exploratory and normative forecasting segments) applicable to water resource planning; (2) methodologies proposed in the exploratory segment were modified and tested in phases 2 and 3, and the Delphi technique was used to study the quantitative future of water withdrawal in the Iowa meat packing industry; and (3) several exploratory segment methodologies, integrated into a forecasting system, were used to forecast future irrigated acreage in six Western Iowa counties (Fremont, Harrison, Mills, Monoa, Pottawattamie, and Woodbury). Computer-based simulation of past data and subjective opinions of 'experts' were used to obtain scenarios of both the qualitative and quantitative future. The report concludes that there is a definite role to be played by technology forecasting. Conscientious and knowledgeable application of the described tools by water resource personnel can significantly aid the planning process. (Zielinski-IPA)
W81-00089

SYSTEMS ANALYSIS OF URBAN STORM WATER DETENTION BASINS,
Booker Associates, Inc., Lexington, KY.
D. K. Mynear, and C. T. Haan.
Transactions of the American Society of Agricultural Engineers, Vol 23, No 1, p 112-116 and 120, January-February 1980. 3 Fig, 3 Tab, 11 Ref. OWRT B-046-KY(6).

Descriptors: *Detention reservoirs, *Systems analysis, *Storm runoff, *Urban runoff, Structures, Hydraulic structures, Dams, Design, Planning, Model studies, Mathematical models, Drainage, Floods, Flood control, Design storm, Flood peak, Watersheds(Basins), Detention basins.

Urban storm water detention basins are generally designed without consideration being given to the overall effect and cost of several basins within a single watershed. By considering a system of basins, the total effectiveness of the basins can be increased while the costs are reduced. Computer programs and procedures are presented that make it possible to find a least cost system of detention basins that will control increased flows from urban areas to a predetermined level. (Sims-ISWS)
W81-00102

DEMAND-ELASTICITY-CONSERVATION RELATIONSHIPS,
M. B. Sonnen.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979. Franklin Pierce College, Rindge, NH, p 211-217, 1979. 3 Tab, 2 Ref.

Descriptors: *Land use, *Water conservation, *Mathematical models, Honolulu, Hawaii, Water demand, Numerical analysis, Probability, Equations, Hydrologic data, Agriculture, Political aspects, Land classification, Forecasting, Planning.

An algebraic analysis of the variables that affect water demands is used to show that water conservation may be a somewhat unsteady, infirm, incomplete, unstable cornerstone for our national water policy. A mathematical model designed to solve the monthly relationship between demand and supply for any particular land use category is described. The model can also describe this monthly relationship over a period of years. The complex expression illustrates that the factors of indoor conservation (CI) and outdoor conservation (CO) alone cannot be relied upon to slow the taking of water. The model equation can be differentiated for each independent variable to show which factors control either positive or negative demand. Also, the elasticity of demand factor can be derived for each variable. A calibration exercise was conducted for the Honolulu area where measured demand data were available. Elasticities of demand with respect to variables other than conservation percentage are calculated. The model shows that land use, although politically unpopular, is the most promising way to curtail water demand. Also, land use will be more effective than price increases or the installation of water saving devices. (See also W81-00160) (Seigler-IPA)
W81-00186

RISK MANAGEMENT IN WATER SUPPLY PLANNING,
Washington Suburban Sanitary Commission, Hyattsville, MD.
R. S. McGarry.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 228-244, 1979. 3 Fig, 5 Tab, 2 Ref.

Descriptors: *Washington(DC), *Cities, *Water policy, *Water supply, Task forces, Reservoirs, Potomac River, Droughts, Water shortage, Planning, Urbanization, Forecasting, Water demand, Federal Government, *District of Columbia Metropolitan Area.

The Bi-County Water Supply task force has made marked progress in solving the serious water supply shortage situation of the Washington, DC. metropolitan region. This process comes after 20 years of review and study with no action being taken. The Corps of Engineers, the Congress, and other Federal interests were not close enough or responsible enough to act on the community water supply problem. A citizen's advisory committee also played a major role. In October 1977 a thorough analysis of the supply and demand situation was accepted as showing a major problem in supply. The task force then had two management scenarios developed against which various supply alternatives were measured for feasibility and cost. Of 25 alternatives originally available, all but 7 were rejected for political or regional environmental reasons. The remaining 7 alternatives were for high flow skimming techniques, new storage reservoirs, or a groundwater possibility. The task force selected the alternative that caled for the utilization of a formerly planned Soil Conservation Service reservoir. Federal funding was abandoned and the reservoir will be locally financed. Land is

being acquired and the reservoir is being designed. The success of the task force illustrates that water supply planning is no longer an engineering problem, it has become a political, social, economic, environmental problem. (See also W81-00160) (Seigler-IPA)
W81-00188

6B. Evaluation Process

THE APPLICATION OF PROJECT ANALYSIS TO NATURAL RESOURCE DECISIONS,
Minnesota Univ., St. Paul. Dept. of Agricultural and Applied Economics.
For primary bibliographic entry see Field 6A.
W81-00023

ECONOMIC POTENTIALS FOR AGRICULTURAL WATER-SAVING USING ALTERNATIVE IRRIGATION TECHNIQUES,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 3F.
W81-00024

AN ECONOMIC EVALUATION OF GREENBELT IRRIGATION WITH EFFULENT WATER,
California Univ., Riverside. Dept. of Botany and Plant Sciences.
For primary bibliographic entry see Field 3C.
W81-00025

IMPACT OF ALTERNATIVE ENERGY PRICES, TENURE ARRANGEMENTS & IRRIGATION TECHNOLOGIES ON A TYPICAL TEXAS HIGH PLAINS FARM,
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 3F.
W81-00032

FIVE YEAR RESEARCH PROGRAM 1982-1987: NEW HAMPSHIRE WATER RESOURCE RESEARCH CENTER,
New Hampshire Univ., Durham. Water Resource Research Center.
S. H. Higgens, R. R. Stever, and J. B. Hraba.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-111577, Price codes: A06 in paper copy, A01 in microfiche. Report submitted to Office of Water Research and Technology, October, 1980. 103 p, 11 Fig, 1 Map. 14-34-0001-0131.

Descriptors: *Research priorities, *Water resources, *Water resources institutes, Water Resources Research Act, Water policy, Water management, *New Hampshire, *State water problems, *State water needs, Institutional survey.

Pursuant to the Water Research and Development Act of 1978, a five-year research program was developed for the New Hampshire Water Resource Research Center. The study was submitted to the U.S. Department of the Interior, Office of Water Research and Technology (OWRT), for inclusion in a national plan. Water-related research needs were assessed through the Center's ongoing needs assessment process, augmented by an intensive survey of Federal, State, regional, local, and private institutions involved with water-resources in New Hampshire. The survey spanned a period of eight months, involving over 30 interviews and 35 responses from a mailed questionnaire. In addition, an exhaustive survey of the literature addressing water-resources management, planning and research in the State was undertaken. An analysis of the New Hampshire Water Resource (Section II), its uses (Section III), and the related management and planning mechanisms (Section IV), revealed a comprehensive list of water-related problems and research needs (Section V). Water-related problems and needs were grouped into six catagories: water quality, water supply, natural resources and ecology, energy development, recreation, and flood control. From this statewide tabulation, a subset of problems and needs were selected to be addressed in the Center's five-year research program (Section VI). The selection of research needs was based upon compatibility with the mission and goals of the Center, research capabilities at academic institutions in the State, other ongoing research efforts, and funding availability through the Center.
W81-00040

POTENTIAL USE OF THE TIEBOUT HYPOTHESIS IN WATER RESOURCE PROJECT EVALUATION,
Clemson Univ., SC. Water Resources Research Inst.
E. B. Sigmon, J. C. Hite, E. L. McLean, S. C. Lilley, and P. E. Lovingood, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-113086, Price codes: A06 in paper copy, A01 in microfiche. Technical Report No 86, May 1980. 107 p, 3 Fig, 31 Tab, 75 Ref, 2 Append. OWRT-A-040-SC(1), 14-34-0001-7086, 14-34-0001-8043, 14-34-0001-9043.

Descriptors: *Cost-benefit analysis, *Theoretical analysis, *Water resources, *Project post-evaluation, *Project planning, Model studies, Projects, Programs, Decision making, Project benefits, Project purposes, Environmental control, Econometrics, Welfare(Economics), Economies, Resources, Sulfur compounds, Air pollution, Computer models, Pollutants.

A major problem in water resource planning and project evaluation is lack of a common denominator for use in summarizing the various accounts, especially national economic development and environmental quality accounts, required by Principles and Standards promulgated in 1973. The Tiebout hypothesis, which relates an individuals' choice of residence with Quality of Life (QOL) factors, was extended empirically by evaluating tradeoffs between QOL factors to determine the practicability in using this as an approach to overcome the problem of incommensurates in water resource project evaluation. Application of this hypothesis to evaluation of water resource projects raised major econometric and data problems, and only limited success was achieved in this research. Practical data and measurement problems required that the analysis focus on ambient sulfur dioxide (SD) as the QOL factor under study. The computed exchange rates (between monetary income and ambient quality) ranged from $3 to $33/capita/ton SD/sq mi. While there was no formal test of these rates, they were evaluated relative to their usefulness and reasonability. Additional research was suggested for refining econometric tools and improving data accuracy, but it was tentatively concluded that the Tiebout hypothesis can provide a practical aide in project evaluation. (Zielinski-IPA)
W81-00073

DEVELOP WATER MANAGEMENT METHODS FOR WATERSHEDS SUBJECT TO INTENSIVE DEVELOPMENT,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
D. Davis, and H. B. Robotham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-114837, Price codes: A04 in paper copy, A01 in microfiche. Partial Project Completion Report, September, 1980. 58 p, 13 Fig, 13 Tab, 23 Ref, 1 Append. OWRT-A-069-ARIZ(3), 14-34-0001-6003.

Descriptors: *Water management(Applied), *Watershed management, *Algorithms, *Reservoir construction, Water resources, Economic evaluation, Water demand, *Arizona, Computer programs, Water supply development, Alternate water use, Area redevelopment, Water utilization, Estimating, *Sonorita Creek watershed(AZ).

This study, undertaken due to increased concern over the adequacy of the Sonorita Creek watershed in meeting future water demands in the Patagonia-Sonorita area in Arizona, investigated various water resources management alternatives for the watershed. While agricultural and recreational demands are expected to remain fairly constant, municipal and domestic demands are expected to triple over the next twenty years. Six potential water resources management alternatives were developed and compared using standardized cost-effectiveness methodology, allowing for intercomparisons of these alternatives with respect to quantifiable and inquantifiable criteria. Each alternative considered development of either ground-water or surface water resources of the watershed, as well as a method for disposal of treated sewage. Selection of a watershed plan was made using the ELECTRE I algorithm, due to its established utility in multiobjective decision problem analysis. Based on use of available ground and surface water resource information for the watershed with this approach, the most optimum alternative specified construction of a small reservoir at Redrock Canyon having evaporation control measures as a supplemental water source for Patagonia, Arizona, and for the Sonorita Creek Sanctuary. (Zielinski-IPA)
W81-00074

CHARACTERIZATION AND LAND APPLICATION OF SEAFOOD INDUSTRY WASTEWATERS,
North Carolina State Univ. at Raleigh. School of Agricultural and Life Sciences.
M. R. Overcash, and D. Pal.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-114654, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute, University of North Carolina. Report No 142, August 1980. 33 p, 7 Fig, 9 Tab, 16 Ref. OWRT-B-100-NC(10), 14-34-0001-7173.

Descriptors: *Industrial wastes, *Commercial fishing, *Seafood industry, *Waste assimilative capacity, Methodology, Nutrients, Wastes, Waste identification, *Land management, Sites, Soil types, Clay loam, Sandy loam, Shrimp, Crab, Tuna, Oyster.

Soil-plant systems are capable of utilizing seafood industry waste water with little or no pretreatment requirements. Raw waste from seafood processing plants contain substantial plant nutrients including nitrogen, phosphorus and calcium. In calculating a capacity for soil-plant assimilation of waste effluents, land areas necessary for the environmental compatible operation of a treatment site were estimated. Four segments of the seafood processing industry: (shrimp, crab, tuna and oyster) were selected for land treatment evaluation. Bulk volume and composition of waste were characterized for average size plants. One objective was to further demonstrate the utility of a recently developed complete design procedure for land treatment of the entire waste stream from any given industry. Two common soil characteristics were focused on as representing significantly different soil textures: (1) a sandy loam, and (2) a clay loam soil. When compared to a sandy loam site, a clay loam site reduced the land needs for shrimp and crab processing. It had no effect on tuna wastes. Oyster land areas were increased in going to a clay loam site. It is generally recommended that a detailed design is needed prior to land treatment because of probable variations in site and waste characteristics. (Stiles-IPA)
W81-00079

A LINEAR PROGRAMMING MODEL OF AGRICULTURAL ACTIVITY AND RESOURCE USE UNDER CHANGING RESOURCE CONDITIONS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 3F.
W81-00083

ANALYSIS BARRIERS TO IMPROVING THE HYDROELECTRIC POWER INTERFACE WITH ELECTRIC POWER SYSTEMS,
Camp Dresser and McKee, Inc., Waltham, MA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-117244, Price codes: A05 in paper copy, A01 in microfiche. Final Report prepared for the Office of Water

Research and Technology, September 30, 1980. 87 p. OWRT-C-90237-T(no 9625)(1), 14-34-0001-9625.

Descriptors: *Hydroelectric power, *Electric power production, *Electric power industry, Analysis, Reservoir storage, Pumped storage, Utilities, Constraints, Optimization, *Hydro/thermal scheduling, Load management, Economic dispatch, Demand forecasting, Unit commitment, Public Utilities Regulatory Policy Act of 1978, Analysis barriers.

The analysis barriers to improving the interface of hydroelectric power with electric power systems are investigated and discussed. The value of hydropower to society and the utilities is explored touching on the problems of weather and hydrological dependencies, multiple-use conflicts and engineering aspects. Special attention is afforded to the organizational structure of the electric utility industry and the operational and planning functions as they relate to hydroelectric power production. Analytical approaches taken to optimize the use of hydropower over time are surveyed. Current barriers to these approaches are presented along with future research topics which potentially may alleviate them.
W81-00121

PREDICTING WATER USE CONSIDERING CONSERVATION,
Johns Hopkins Univ., Baltimore, MD.
J. J. Boland, and P. H. Carver.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 88-93, 1979. 1 Tab, 8 Ref.

Descriptors: *Water conservation, *Water utilization, *Mathematical models, *Forecasting, Estimating, Water supply, Measurement, Water demand, Planning, Equations, Water users, Water rates, Water allocation, Disaggregate demand forecasts.

An expression for the prediction of the effectiveness of water conservation measures is discussed and defined as the quantity of water per unit time which is expected to be saved through implementation of a measure. Conservation measures are classified by the user class affected and by the time of implementation. In general quantitative estimates are deficient because they are 'a priori' engineering estimates, are based on casual empiricism, or are stated in terms of water use at an inappropriate level of aggregation. Water conservation measures may be classified as behavioral modification such as improved use practices, leak repair, economic incentives, and water use regulation or as technological change such as water-saving toilets, faucet aerators, and the substitution of other inputs. A two step procedure is needed for forecasting. First unrestricted water use must be estimated then the aggregate effectiveness of the conservation measures can be determined and deducted to yield a future forecast. General conclusions concerning forecasting are that water conservation measures must be explicitly considered in forecasting future water use, a disaggregate demand approach should be used instead of the widely-used per capita requirement approach, and more data and research are needed on disaggregate demand forecasts and on actual applications of conservation measures. (See also W81-00160) (Seigler-IPA)
W81-00170

TECHNOLOGY ASSESSMENT FOR WATER RESOURCE MANAGEMENT IN URBANIZING AREAS,
Gates (W.E.) and Associates, Inc., Fairfax, VA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-119570, Price codes: A04 in paper copy, A01 in microfiche. Completion Report presented to Office of Water Research and Technology, September, 1980. 69 p, 4 Fig, 335 Ref. OWRT-C-90226-T (No 9626)(1).

Descriptors: *Water resources, Mathematical models, *Urbanization, *Evaluation, *Hydrology, *Water supply, *Water sources, *Recreation, *Institutions, Technology, Methodology, Research and development, Planning, Water resources development, Mathematical studies, City planning, Urban hydrology, Urban sociology, Suburban areas, Statistics, Statistical methods.

This technology assessment focused on an evaluation of existing technologies for water resource management in urbanizing areas and the development of recommendations for research priorities that would enhance the technologies. The water resource management elements studied were hydrology, water supply, nonpoint sources, recreation, and institutions. Two distinct approaches to water resource management in urbanizing areas were considered: (1) the economic (demand) approach (required carrying capacity supplied by a combination of resident capacity and capacity derived through various service delivery systems); and (2) the ecologic (control) approach (carrying capacity fixed at a prescribed level). The existing technologies were viewed within four states of understanding: phenomenological, empirical, statistical, and deterministic. Recommendations for the five management elements were formulated. These were for research on application of spatial processes suggested in the Hewlett phenomenological model (hydrology); on conceptualization of a watershed as a reactor and its characterization (nonpoint sources); on phenomenological model development (recreation); on implications of removing institutional constraints on implementing technologies (water supply); and on the timing and geographic extent of water resource management institutions (institutions). (Zielinski-IPA)
W81-00190

AN ASSESSMENT OF NONPOINT SOURCE TECHNOLOGY FOR WATER RESOURCE MANAGEMENT IN URBANIZING AREAS,
Gates (W.E.) and Associates, Inc., Batavia, OH.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-118788, Price codes: A04 in paper copy, A01 in microfiche. Completion Report prepared for Office of Water Research and Technology, September, 1980. 68 p, 1 Fig, 1 Tab, 41 Ref, 1 Append. OWRT-C-90226-T(No 9626)(1).

Descriptors: *Water resources, *Mathematical models, *Urbanization, *Evaluation, *Water sources, Hydrology, Water supply, Recreation, Institutions, Technology, Methodology, Research and development, Planning, Water resources development, Mathematical studies, City planning, Urban hydrology, Urban sociology, Suburban areas, Statistics, Statistical methods.

Fourteen comprehensive models of the nonpoint source process were reviewed, and their space-time characteristics and component processes described (Appendix:31 p, 8 tab, 11 fig). With only one exception, comprehensive model components were empirical or deterministic, with the current trend being the use of deterministic relationships. This exception, the ADAPT statistical NPS model, should have resulted in more operational models in light of the large field data sets (urban and rural) collected over the past decade. The empirical-deterministic component formulations were all generally derived from a few basic models. Also, there appeared to be a trend towards greater incorporation of spatial characteristics in more recent models. Historically, nonpoint source research has been segregated into three areas: urban analysis, sediment modeling, and chemical modeling. A minimal level of evolutionary conceptual research has occurred relative to the work spent on aggregating modules within these three areas into a comprehensive model, and emphasis more on mathematical models than on conceptual understanding has led to significant problems greatly affecting the capacity to model nonpoint sources. The primary research requirement is to establish a common framework in which nonpoint source research and modeling may be placed. A proposed watershed reactor concept provides such a general framework. (Zielinski-IPA)
W81-00191

TECHNOLOGY ASSESSMENT OF HYDROLOGY FOR WATER RESOURCE MANAGEMENT IN URBANIZING AREAS,
Gates (W. E.) and Associates, Inc., Batavia, OH.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-118754, Price codes: A05 in paper copy, A01 in microfiche. Completion Repot prepared for Office of Water Research and Technology, September, 1980. 11 p, 1 Fig, 32 Ref, 1 Append. OWRT-C-90226-T(No 9626)(1).

Descriptors: *Urban hydrology, *Water resources, Rainfall-runoff relationships, *Mathematical models, Urbanization, Evaluation, Surface-groundwater relationships, Water supply, Water sources, Recreation, Institutions, Technology, Methodology, Planning, Water resources development, Mathematical studies, City planning, Hydrology, Statistics, Suburban areas, Research and Development.

The historical development of rainfall-runoff models is discussed (Appendix: 33 p, 24 fig, 78 ref.) with emphasis placed on the evolution of the models and their responsiveness to the changing spatial requirements in rainfall-runoff and nonpoint source modeling. Primary emphasis in hydrologic analysis has been rainfall-runoff modeling; the prediction of how a watershed/catchment transforms rainfall into stream flow. Model development occurs through an iterative process involving phenomenological, statistical-empirical, and deterministic model forms. Rainfall-runoff modelling is currently in a stage in the iterative development process between two phenomenological models. All operational rainfall-runoff models are largely based on the outdated Horton model, while broad-based general acceptance has occurred for the spatially-based Hewlett model. It would appear that the major need today in rainfall-runoff modelling is in research to understand and formalize the spatial processes suggested in the Hewlett model. A requisite to construction of a complete phenomenologic model are data on the actual spatial/temporal path followed by water under a wide range of physiographic conditions. Field work using tracers was suggested as one means of developing such data. (Zielinski-IPA)
W81-00192

LITERATURE REVIEW FOR WATER SUPPLY FOR URBANIZING AREAS,
Howard (Charles and Associates Ltd., Vancouver (British Columbia).
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-119547, Price codes: A03 in paper copy, A01 in microfiche. W. E. Gates and Associates, Inc., Fairfax, VA. Completion Report prepared for Office of Water Research and Technology, September, 1980. 25 p, 6 Fig, 2 Tab, 115 Ref. OWRT-C-90226-T(No 9626)(1).

Descriptors: *Publications, *Reviews, *Water supply, *Urbanization, *Statistical methods, Water resources, Evaluation, Hydrology, Urban hydrology, Water sources, Recreation, Institutions, Technology, Methodology, Research and Development, Planning, Water resources development, Mathematical studies, City planning, Suburban areas, Statistics.

This study involved the development of recommended strategies for future research investment in water sources for urbanizing areas, providing background information related to water supply, treatment, and distribution. To quantify the recommendations, the most recent literature in the field was summarized, classified, and analyzed to identify past research trends. The review was confined to articles published within the last two years, covering 450 articles for analysis by multiple classification systems and a statistical approach. Fifty-one of these, published between 1978-1980 dealt with some type of problem associated to water resources for urbanizing areas; the remainder dealt primarily with industry or pure hydrology related problems. Information extracted from the 51 articles were classified using four independent schemes: primary subject matter, level of specificity, level of sophistication, and author's research approach. Each article was read and classified in all four schemes. Most research was found in the water treatment field, compared to water supply quantity aspects. The literature indicated that im-

plementation of existing technology, especially during draught periods, represented troubled areas. (Zielinski-IPA)
W81-00193

TECHNOLOGY ASSESSMENT AND RESEARCH NEEDS OF WATER-BASED RECREATION FOR URBANIZING AREAS,
Wright-McLaughlin Engineers, Denver, CO.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-118812, Price codes: A07 in paper copy, A01 in microfiche. W. E. Gates and Associates, Inc., Fairfax, VA. Completion Report prepared for Office of Water Research and Technology, September, 1980. 141 p, 22 Fig, 1 Tab, 49 Ref, 1 Append. OWRT-C-90226-T(No 9626)(1).

Descriptors: *Recreation, *Water supply, *Urbanization, *Water sports, *Research priorities, *Land use, *Statistical methods, Water resources, Evaluation, Hydrology, Water sources, Institutions, Technology, Methodology, Research and Development, Planning, Water resources development, City planning, Urban hydrology, Suburban areas, Statistics.

The recreation planning process was studied with special emphasis on its application to urbanizing areas and on water-based recreation. Available technologies were examined as to how each fits within the planning process. A description of the methodology of each with examination of its level of sophistication was carried out (phenomenological-empirical-stochastic-deterministic), and critiqued to identify potential research areas. Nine suggested research areas were prioritized by evaluation of the probable value derived from research expenditures. The highest priority was general research for a coordinated comprehensive approach to general land use planning for urbanizing areas, prior to the undertaking of more detailed research into specific areas. Other suggested priorities included a substantial improvement in economic variation of the whole planning process for urbanizing areas, and improvement in application of the survey method to improve the definition of desires and needs of a future population. A comprehensive bibliography on recreation planning (325 references) is given in the appendix. (Zielinski-IPA)
W81-00194

EXISTING BASE AND RELEVANT PRACTICES -- INSTITUTIONAL ARRANGEMENTS FOR WATER RESOURCE MANAGEMENT IN URBANIZING AREAS,
Robinson, Farmer, Cox Associates, Richmond, VA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-119562, Price codes: A03 in paper copy, A01 in microfiche. W. E. Gates and Associates, Inc., Fairfax, VA. Completion Report prepared for Office of Water Research and Technology, September, 1980. 45 p, 3 Tab. OWRT-C-90226-T(No 9626)(1).

Descriptors: *Institutions, *Urbanization, *Water resources, *City planning, *Water supply, *Evaluation, Hydrology, Water sources, Technology, Methodology, Research and Development, Planning, Water resources development, Statistical methods, Urban sociology, Suburban areas, Water management.

Specific problems seen in other areas of the study (water supply, drainage, nonpoint source pollution and water-based recreation) were seen as being able to be remedied by improving the powers, geographical jurisdiction, and timing of institutions intended to manage a water resource. It was concluded that there is political support for their exercise. Research concluded as being helpful to these areas was identified in a list of twelve program reseach elements. These research elements included: investigating the divergence in popular opinion that regional water resources agencies are better, yet such institutions are rarely found; determining how institutions can be organized and established sufficiently early in the urbanization process for design and construction of institutions in an urbanizing area; devising state or other supralocal strategy for establishing timely, effective, and appropriate local institutions for water resource management in urbanizing areas; and describing the impact of water resources on the real estate market during the urbanization process. (Zielinski-IPA)
W81-00195

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER DISTRICT REVENUE IMPLICATION OF CONSERVATION,
East Bay Municipal Utility District, Oakland, CA. D. G. Larkin, and K. E. Carns.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 204-210, 1979. 1 Tab.

Descriptors: *California, *Water conservation, *Water rates, *Economic impact, Prices, Water utilization, Utilities, Water works, Droughts, Water shortage, Costs, Income, Planning, Profit, Economic prediction.

Water conservation is the single most important factor which has triggered revenue problems for the East Bay Municipal Utility District in Oakland, California. Following the 1976-1977 drought, water consumption levels have not returned to predrought levels and are now at about 83% of the normal pre-drought level. Consumption is expected to rise only to 90% of normal in the early 1980's despite increasing numbers of customers. Customers' water bills have increased from the predrought level of $4.70/month to the current $7.00/month to help offset the financial losses due to conservation. An even greater increase has occurred in industrial and commercial bills. Revenue problems caused by conservation have been further heightened by inflation, Proposition 13, delayed rate increases, and the development of new water risk schedules. Innovative utility financial policies will be needed to meet the increasingly unpredictable future. Conservation must be considered in planning and more frequent reviews of water rates will have to be conducted. (See also W81-00160) (Seigler-IPA)
W81-00185

6D. Water Demand

STATE INVOLVEMENT IN WATER DEVELOPMENT OF SMALL AREAS,
Tennessee Univ., Knoxville.
S. P. Coelen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-110751, Price codes: A05 in paper copy, A01 in microfiche. Institute for Research on Land and Water Resources, The Pennsylvania State University, University Park, Research Project Technical Completion Report, Sept. 1980, 92 p, 5 Fig, 8 Tab, 14 Ref. OWRT A-037-PA(1), 14-34-0001-9040.

Descriptors: *Water resources development, *Rural areas, *Analysis, *Pennsylvania, *Water supply development, Water utilization, Sewerage, State involvement, Evaluation, Rural water problems, Water firms, Capital subsidies, State financing, Sanitarians.

An institutional and theoretical analysis is presented of the role that states should play in providing water to rural areas. The research question addressed is: If private suppliers are to continue providing water in rural areas, is a subsidy system necessary or desirable. The initial conception of this question was made by the Water Supply Task Force Committee (WSTFC) of the state of Pennsylvania. In response to the research needs stated by WSTFC, the analysis done here is predominantly economic in perspective. Several social, political, and engineering aspects of the problem are left unaddressed. The analysis is conducted in two parts: (1) an evaluation of the historical record of state involvement in rural water problems, surveying all the states to assess their comparative record of involvement; and (2) an analysis of both the theoretical values and appropriate limitations of state involvement.
W81-00015

ANALYSIS BARRIERS TO IMPROVING THE HYDROELECTRIC POWER INTERFACE WITH ELECTRIC POWER SYSTEMS,
Camp Dresser and McKee, Inc., Waltham, MA.
For primary bibliographic entry see Field 6B.
W81-00121

FIVE-YEAR WATER RESOURCES RESEARCH AND DEVELOPMENT PLAN FOR THE STATE OF MONTANA,
Montana State Univ., Bozeman. Water Resources Research Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-119596, Price codes: A04 in paper copy, A01 in microfiche. Report submitted to the Office of Water Research and Technology, October, 1980. 47 p, 1 Fig, 2 Tab, 28 Ref, 8 Append. 14-31-0001-0128.

Descriptors: *Research priorities, *Montana, *Research and Development, *Planning, *Water resources, Institutions, Local governments, Federal government, Operations, Project planning, Water resources development, Water supply, Water sources, Potential water supply, Scheduling, Programs, Forecasting, Reservoirs, Water consumption, Agricultural watersheds, Irrigation.

The report, developed to meet requirements of the Water Research and Development Act of 1978, documented Montana water resources and related land-use problems, and presented a prioritized research agenda to improve a comprehensive planning/management program to meet Montana's water resources needs. Agriculture is the major water consumer, accounting for 95 percent of the water used in the State. Reservoirs provide about 28 million acre-feet of live storage in order to maintain streamflow through the summer in major streams, yet major problems occur in provision of water qualities needed during low flow periods in needed locations. Sufficient unappropriated water is available for increased uses at present and for demands projected through the year 2020. The major water-related problems lay in providing water in locations where it is needed when it is needed. The five-year program recommends that funding of the Water Center research projects be encouraged in support of agencies engaged in studies most critical to State, regional, and national water problems. The most significant water quality problems identified were from sediments and salts from nonpoint pollution sources, and from reduced streamflows due to withdrawals. (Zielinski-IPA)
W81-00196

6E. Water Law and Institutions

INCENTIVES FOR AGRICULTURAL WATER CONSERVATION,
Sonnen (M. B.) Co., Inc., Walnut Creek, CA.
For primary bibliographic entry see Field 3F.
W81-00003

THE POLITICAL FEASIBILITY OF ALTERNATIVE STRATEGIES FOR MANAGING WATER DEMAND IN SOUTHERN ARIZONA,
Arizona Univ., Tucson. Dept. of Political Science.
J. R. McCain.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-109803, Price codes: A04 in paper copy, A01 in microfiche. Project Completion Report, September 15, 1980, 45 p. OWRT A-085-ARIZ(2), 14-34-0001-8003.

Descriptors: *Political aspects, *Water law, *Water demand, Pricing, Planning, *Water resources development, *Arizona, Water management problems, Decision making, Water policy.

Decision-makers are restricted in their choice of alternative policies by physical, economic, attitudinal and legal/institutional constraints, all of which may or may not be operative in any particu-

lar situation. This report examines the interrelationships between attitudinal and legal constraints in the context of policies for the local development, use and management of water resources in Tucson, Arizona. The attitudinal constraints are identified as those images or beliefs which compose the 'water-is-different' syndrome--specifically the 'free-good,' 'desert,' and 'survival' images of water. The legal/institutional constraints are discussed in terms of water laws--both statutory and common. The effect of these constraints on water policy, in Tucson and elsewhere, has been to emphasize supply solutions to water management problems. Demand management strategies have traditionally been avoided in water policymaking. In 1976, however, public officials in Tucson did develop and implement policies aimed at reducing demand for water. Although these demand management policies appear to have been ultimately successful, the changes did not come without costs. The innovative actions of these public officials precipitated a political crisis in which they were actually turned out of office. Ironically, this crisis may have also had the unexpected effect of institutionalizing a demand management system in Tucson.
W81-00007

SOME IMPLICATIONS OF WATER LAW AND RIGHTS TOWARDS LAND USE PLANNING: VERMONT CASE STUDIES,
Vermont Univ., Burlington.
P. J. Folkman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-111270, Price codes: A05 in paper copy, A01 in microfiche. MS Thesis, 1980. 86 p, 4 Fig, 2 Tab, 128 Ref. OWRT-A-035-VT (1), 14-34-001-9048.

Descriptors: *Water law, *Water resources planning, *Land use, *Riparian land, Watercourses(Legal aspects), Common law, Water pollution control, Surface water availability, Groundwater availability, Vermont water law, Winooski River(VT).

A theory that water law and rights have an effect on land use planning and therefore should be included as a component in the land use planning process is proposed. Research presented summarizes Vermont's common, statutory, and administrative water laws and rights. Three Vermont case studies are examined which substantiate the proposed theory. The case study examples include a diversity of water resources and laws such as: running waters (rivers) and administrative law; standing surface water (lake) and administrative and statutory law; and ground water and the common law. The case studies identify some implications these various water laws have on the land use planning process. The primary conclusion is that a review of water laws and rights should occur at the data collection stage in the land use planning process to preclude land use planning and water law conflicts.
W81-00010

LEGAL AND PROCEDURAL PROBLEMS OF THE ADMINISTRATION AND ENFORCEMENT OF WATER RESOURCES LAWS AND REGULATIONS,
West Virginia Univ., Morgantown. Water Research Inst.
V. P. Cardi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-110744, Price codes: A03 in paper copy, A01 in microfiche. Technical Completion Report, 1980. 33 p. OWRT-A-027-WVA (1), 14-31-0001-5059.

Descriptors: Administrative decisions, Judicial decisions, Law enforcement, *Legal aspects, Regulation, *West Virginia, *Water law, *Water pollution, Adjudication procedure, Administrative agencies, Decision making, Local governments, Legislation, Management, Penalties(Legal), Political aspects, Sewage districts, Water policy, Water users.

The purpose of the study was to investigate and determine what problems exist in the administration of West Virginia water laws and regulations as perceived by those involved as consumers of water resources and by those involved in the processes of delivering and regulating water services. Conclusions reached are that many persons having water-resource problems feel they receive inadequate assistance from available attorneys, building and road contractors do not feel hampered by problems in water law, diversion of surface (sheet) runoff in residential areas is not handled adequately by the 'common law' or 'common enemy' rule, normal difficulty in attaching responsibility for water and siltation damage caused by major construction performed by a private party or by the state is made much more difficult if both the state as owner and a private party as contractor are involved, law guiding the right of local sanitary districts to deny service to new customers and to terminate existing but unauthorized customer use is uncertain and confusing, and the statutory scheme of the Water Resources Board and the form and procedure of its practice are in need of change that should include movement toward a full-time professional board and other major changes.
W81-00014

FIVE YEAR RESEARCH PROGRAM 1982-1987: NEW HAMPSHIRE WATER RESOURCE RESEARCH CENTER,
New Hampshire Univ., Durham. Water Resource Research Center.
For primary bibliographic entry see Field 6B.
W81-00040

WATER SHORTAGES IN THE SOUTHEAST,
North Carolina Water Resources Research Inst., Raleigh.
D. H. Howells.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, Franklin Pierce College, Rindge, NH, p 147-155, 1979. 2 Ref. OWRT-B-123-NC-(8)-B-125-NC-(7).

Descriptors: *Water conservation, *Water shortage, *Southeast U. S., Humid areas, Wet climates, Water allocation(Policy), Equitable apportionment, Riparian rights, Water law, Water sources, Planning, Saline water intrusion, Urbanization, Recharge, Groundwater.

Although the Southeast is in general a humid region with abundant precipitation, perennial water shortages are of increasing concern. These shortages are caused by disparities between timing and location of supply and demand and individual system deficiencies. These problems are expected to increase due to population growth, industrial production, and agricultural irrigation. Some States in the area are considering switching from the riparian to the prior appropriation doctrine as a means of water allocation. Legislation in Mississippi, North Carolina, South Carolina, and Virginia has made provisions for the allocation of groundwater. Florida has taken the most far-reaching allocation steps with administrative regulation of surface and groundwater withdrawals. To ultimately balance water supplies and demand, transriparian and interbasin transfer will be needed. More study is needed in areas such as minimum streamflows, drought and emergency allocations, preservation of needed reservoir sites, protection of groundwater recharge areas, saline water intrusion, and other pollution and protection concerns. New mechanisms for interstate cooperation during times of water shortage are also needed. A comprehensive system involving State and regional water resources planning and management is needed to provide an overview and areawide perspective of how to best use available water supplies. (See also W81-00160) (Seigler-IPA)
W81-00178

DROUGHT EFFECTS ON METROPOLITAN WASHINGTON, D.C. AREA,
Corps of Engineers, Baltimore, MD.
J. E. Crews, and W. E. Trieschman.
In: Proceedings of the Conference on Water Conservation Needs and Implementing Strategies, July 9-13, 1979, Franklin Pierce College, Rindge, NH, p 156-164, 1979. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Washington(DC), *Water allocation(Policy), *Potomac River, Droughts, Low flow, Water shortage, Urbanization, Virginia, River flow, Water conservation, Planning, Water supply, Utilities, Water works, Suburban areas.

The Metropolitan Washington Area (MWA) depends on the Potomac River for most of its water supply. The river is unregulated and flows fluctuate widely with an average of 6,000 million gallons per day. This average is more than enough to meet current and future demands, however, during periods of drought this average drops sharply and steps are being taken to assure equitable allocation during such times. In the 1970's, two adjoining areas were given permission to tap the Potomac, the Washington Suburban Sanitary Commission (WSSC) and the Fairfax County Water Authority (FCWA). Recognizing that a critical situation could develop during times of low-flow, the utilities for MWA, WSSC, and FCWA signed a Low Flow Allocation Agreement in January 1978. Under the agreement all utilities could share the available water according to a predetermined formula. This agreement provides for fair allocation of existing water but it will not eliminate shortages. Each of the utilities has therefore set up water shortage emergency plans. Also, the Corps of Engineers is conducting a water supply study for the most efficient use of existing supplies before new water sources are developed. Four plans have been formulated for the future, all of which include a water conservation program. (See also W81-00160) (Seigler-IPA)
W81-00179

MEDITERRANEAN STATES AGREE ON TREATY TO CONTROL LAND-BASED POLLUTION,
I. Guest.
Ambio, Vol 9, No 3-4, p 194-195, 1980.

Descriptors: *Mediterranean Sea, *Water pollution sources, *Water pollution control, *International commissions, Regulation, Water pollution, Rivers, DDT, Pesticides, Heavy metals, Industrial wastes, Sewage, Toxins, Costs, Legislation, Oceans.

A treaty was proposed by fifteen of the states bordering the Mediterranean Sea and by the European Economic Community to control land-based sources of pollution in the sea. It is estimated that 85% of the pollution in the Mediterranean Sea comes from the land, most of it carried by rivers. An estimated 90 tons of DDT and other pesticides flow into the sea yearly, as well as tons of heavy metals, industrial wastes, and untreated sewage. Cleaning up the sea will cost $10-15 yr. The agreement established a list of toxic substances so dangerous that their emissions are banned altogether (e.g. mercury, cadmium, radioactive substances and lubricating oils) and a list of 20 substances which will be allowed in strictly controlled quantities (e.g. lead, silver, tin). Limits of tolerance must be established by the cooperating states. Now that the various governments have recognized their common problem, the scientific community will have to resolve differences of opinion as to what constitutes pollution. Problems remaining include argument over the site of the program secretariat and enforcement of the agreement. (Baker-FRC)
W81-00213

THE INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION DECADE PREPARES FOR LAUNCHING,
World Health Organization, Geneva (Switzerland). Div. of Environmental Health.
G. Schultzberg.
Ambio, Vol 9, No 3-4, p 201-202, 1980. 1 Fig.

Descriptors: *Potable water, *United Nations, *Water resources development, *Public health, Water supply, Environmental sanitation, International commissions, Attitudes, Administrative agencies, Projects, Programs.

Plans are discussed for the International Drinking Water Supply and Sanitation Decade (beginning

November 1980) supported by the Economic and Social Council of the United Nations. The goal of the program is to adopt programs with realistic standards of quality and quantity of water supplies for both rural and urban areas of the world by 1990. A rapid assessment exercise by Member States revealed that few countries have taken steps to put the goal into action. However, the fact that over 100 countries are participating in the assessment phase is seen as encouraging. Completion of the goal may be slowed by a lack of manpower to prepare plans and programs. The success of the Decade will depend on the initiative of each country and its willingness to act. Changes will be needed both in attitudes and in approaches to sanitation and health care in developing countries and among multilateral and bilateral agencies involved. (Baker-FRC)
W81-00214

WATER POLLUTION ABATEMENT PROBLEMS AROUND LIVESTOCK,
Nebraska Univ.,-Lincoln.
C. B. Gilberston.
Agricultural Engineering, Vol 61, No 8, p 24-25, August, 1980. 1 Fig.

Descriptors: *Agricultural runoff, *Water pollution control, *Feed lots, *Permits, *Administrative agencies, Legislation, Environmental Protection Agency, Fishkill, Water pollution, Farm wastes, Regulation, Clean Water Act, Drainage water, Environmental sanitation, State jurisdiction.

Government regulations concerning feed-lot pollution are discussed. Feed lots were identified as sources of water pollution in the 1960s, when fishkills were thought to be due to uncontrolled runoff. Water pollution control laws banning discharge of feed-lot runoff into public streams, lakes or ponds were passed in several states in the 1970s. It was planned at that time that by 1983 all public waters would be safe for fishing, boating and swimming. Permits issued by EPA through the National Pollutant Discharge Elimination System (NPDES) are required for specific capacity feed lots, for situations in which a stream runs through a 300-1,000 head lot, or for any operation which significantly pollutes a body of water. Permit requests are made to a State Water Control Agency or the EPA, after which a preliminary permit is made available for review by the livestock operator, the interested state agency, and the public. Permits are valid for 5 yr. Effluent limits stated in the permit are site-specific and comply with NPDES guidelines. Effluent guidelines have, however, been difficult to interpret. Specific management techniques which help reduce pollution include better shaping of feed lots to improve drainage, maintenance of watering equipment, and good sanitation practices. (Baker-FRC)
W81-00229

WATER, WATER EVERYWHERE, BUT LESS OF IT TO DRINK,
K. J. /Scott
Ambio, Vol 9, No 3-4, p 200-201, 1980.

Descriptors: *Clean Water Act, *Potable water, *Water purification, *Industrial water, *Municipal water, Legislation, Water quality, Industrial wastes, Costs, Industrial plants, Water pollution, Public health, Toxins, Water pollution control.

The article briefly reviews the problems encountered over the past several years in efforts to maintain satisfactory quality control for drinking water supplies in the United States. Cost is one of the major factors which makes the program difficult to accomplish. In view of deteriorating quality of water supplies, the Congress passed the Clean Water Act in 1972. This required industrial plants to obtain discharge permits, and provided federal aid for the construction of municipal sewage treatment plants. 1985 was set as the target date by which industrial users were to return water to the source as clean as it was when they removed it. Progress in following the requirements of this act has been mixed. Not only are there problems in the original pollution to be removed, there are now problems created by the by-products of water purification programs. Each new crisis has lead to the restructuring of rules to meet it. However, with each new regulation imposed, arguments are presented by companies complaining that compliance would drive them out of business, or by municipalities claiming that some of these precautions are not necessary for them. (Baker-FRC)
W81-00246

6G. Ecologic Impact Of Water Development

GUIDELINES FOR INTEGRATING GEOLOGICAL AND ARCHAEOLOGICAL INFORMATION INTO WATER RESOURCE PROJECT ENVIRONMENTAL ANALYSIS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
M. Bradley, and D. A. Altshul.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-114019, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, September 1980. 37 p, 13 Ref, 3 Append. OWRT-A-088-ARIZ (2), 14-34-001-8003, 14-34-001-9003.

Descriptors: *Water resources development, *Legal aspects, *Geology, *Archaeology, *Standards, Water resources, Environmental effects, Environmental control, Legislation, Wild River Act, Documentation, Information exchange, Reviews, National Historic sites, State governments, State jurisdiction.

The purpose of this paper was to introduce techniques and develop guidelines for use by public officials conducting interdisciplinary environmental studies, and for integrating this data into environmental impact reports. The general guidelines developed serve as the method for project planners/administrators in conducting cultural resource analysis on Federally funded water projects. The guidelines follow three steps: (1) initial contact with the appropriate State Historic Preservation Officer (SHPO); (2) review of detailed information from private consultants and the SHPO and development and incorporation of recommendations into the text of a prepared report; and (3) the conduct of certain secondary investigative procedures by research staff/consultants for the lead agency. Use of the guidelines in large and small scale analyses was demonstrated. Appendices cover a synopsis of legal authorities and lists of cultural resource institutions (including SHPO's) and museums/historical societies. Authority for archaeological/historical impact analysis was considered in detail, such as the National Environmental Policy Act of 1969, requiring Federal agencies to conduct environmental impact analyses on actions significantly affecting human environmental quality. 'Significance' is elaborated under categories of historical, scientific research, ethnic, and public significance, for the purposes of this report. (Zielinski-IPA)
W81-00045

THE MANGROVE SWAMP - AN ECOSYSTEM IN DANGER,
Swedish Water and Air Pollution Research Lab., Stockholm.
For primary bibliographic entry see Field 4C.
W81-00206

LAKE GENEVA (LEMAN): RESTORING THE BALANCE,
Foundation Ripaille, Thonon-les-Bains (France).
For primary bibliographic entry see Field 5C.
W81-00215

7. RESOURCES DATA

7A. Network Design

RESEARCH PRIORITIES IN TROPICAL BIOLOGY,
National Research Council, Washington, DC. Assembly of Life Sciences.
J. J. Talbot.
Environmental Conservation, Vol 7, No 2, p 99-100, Summer, 1980. 1 Ref.

Descriptors: *Tropical regions, *Research priorities, *Land use, *Ecology, Rain forests, Wet climates, Water resources, Rivers, Lakes, Watershed management, Water chemistry, Aquatic life, Urbanization, Africa, Asia, South America.

The international Committee on Research Priorities in Tropical Biology was established to devise ways of increasing the pace of basic research, concentrating on promising scientific and geographic areas. It functioned between March 1978 and March 1980 but may now be disbanded. The committee used the following criteria when choosing research topics: urgency due to imminent change in an ecological or biological system, and potential significance to biology and its supporting disciplines. The Committee recommended that the pace of biological inventory be increased in tropical regions in the next two decades. Tropical ecosystem studies, including water and nutrient cycling investigations, were urged for various forest areas. Studies of major rivers, lakes, streams, and wetlands of the tropics are of scientific importance, especially as changes such as watershed deforestation, impoundment for energy production and flood control, and urban and industrial pollution will occur in these areas. Particular areas to study include the Amazon, Orinoco, and Zaire rivers, as well as the Musi (Sumatra) and Purari (New Guinea), Lakes Valencia and Maracaibo (Venezuela), Malawi, Titicata, and volcanic lakes in southeast Asia, and wetlands like the Sudd and Benguelu in Africa, the varzea of the Amazon and Orinoco basins, and the peat swamps in southeast Asia. Water chemistry and nutrient processing, plankton, fishes, bottom fauna, certain vertebrates, and land-water interactions should be studied in these areas. (Gish-FRC)
W81-00212

7B. Data Acquisition

THE ROLE OF ZOOPLANKTON VERTICAL MIGRATION IN STRUCTURING THE PHYTOPLANKTON COMMUNITY,
New Hampshire Univ., Durham. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W81-00021

FREQUENCY OF AGRICULTURAL AND FOREST DROUGHT IN NEW HAMPSHIRE: 1926 - 1975,
Northeastern Forest Experiment Station, Durham, NH.
C. A. Federer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-111254, Price codes: A03 in paper copy, A01 in microfiche. Research Report No 26, 1980. 37 p, 8 Fig, 1 Tab, 16 Ref, 3 Append. Water Resource Research Center, University of New Hampshire, Durham. OWRT-A-999-NH (6).

Descriptors: *Drought, *Agriculture, *Forest drought, *Soil water, New Hampshire, Soil moisture, Moisture deficit, *Soil water deficits, Agricultural drought, Water deficits.

Agricultural drought is defined as a shortage of soil water for plant growth. It can be quantified in terms of soil-water deficits during the growing season. A hydrologic simulation model called BROOK was used to estimate daily soil-water deficits from daily precipitation and mean temperature for 50 years (1926-1975) at three New Hampshire locations: Berlin, Durham, and Keene. In the simulated soil, which had about 120 mm of available water, deficits greater than 60 mm may indicate occurrence of agricultural drought. This deficit is exceeded about half the time between mid-July and mid-September at all locations. Both the number of days with deficits larger than 60 mm and the mean deficit from June through August are satisfactory measures of dryness of different summers. In most

years dryness at one location was not related to dryness at the other locations, indicating that agricultural drought in New Hampshire is a local rather than a regional phenomenon. Graphs provide data on the frequency of a drought of a given length, timing, and intensity. For example, on August 1 a run of deficits exceeding 75 mm for 30 days occurred in about 15% of the years at Keene and Durham and in 7% of the years at Berlin. Soil water was always recharged before late December, so agricultural drought did not carry over from one summer to the next. Estimates of soil-water deficits are much more satisfactory than precipitation for studying the relation of drought occurrence to plant growth.
W81-00034

WATERSHED INFORMATION SYSTEM,
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
A. G. Thomsen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-115701, Price codes: A09 in paper copy, A01 in microfiche. Ph.D. Dissertation, Spring 1980. 161p. OWRT-B-160-COLO(3), 5-31640.

Descriptors: Snow, *Snowmelt, Hydrologic models, *Remote sensing, *Model studies, *Streamflow, Satellites(Artificial), Aerial photography, Computer program, Watersheds(Basins), Water equivalent, Topography, Vegetation, Soils, Colorado, Rocky Mountain Region, Mountain watersheds.

A watershed information system for the analysis and simulation of mountain watersheds is described. Watershed information on topography, vegetation and soils in digital terrain models (overlays) serve as the data base for watershed analysis, classification of snow in Landsat imagery and automatic generation of parameter decks for operating distributed simulation models of snowcover dynamics and streamflow generation. The computer programs that generate the parameter decks have built-in calibration options for all major processes, that permit fast model calibration from an interactive computer terminal, on watersheds with varying characteristics. Snow processes are simulated within square (5.76 ha) grid-cell elements. The hydrograph resulting from spring snowmelt is simulated by a lateral flow model of streamflow generation driven by the simulated spatially distributed input (snowmelt and rain). Options are available for simulating the effects of forest management alternatives (thinning, clearcutting) on selected forest stands. Line printer generated map overlays showing simulated snowcover parameters (depth, temperature) as well as the moisture content of the rooting zone, can be produced for any date between April 1 and July 31.
W81-00081

APPLICATIONS OF REMOTE SENSING IN HYDROLOGY,
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
D. C. Fitz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-111932, Price codes: A07 in paper copy, A01 in microfiche. M.S. Professional Paper, May 1980. 131 p. OWRT-B-160-COLO(2), 5-31640.

Descriptors: *Remote sensing, *Hydrology, *Surface waters, *Subsurface water, *Instrumentation, Watershed characteristics, Aerial photography, Satellites(Artificial), Infrared radiation, Mapping, Water quality, Available water, Snow cover, Vegetation, Soils.

This paper is a summary of the potential applications of remote sensing in the field of hydrology. It includes an introduction to remote sensing, the physical principles of electromagnetic energy and many of the available sensors. Operational uses and research applications of remote sensing in areas related to watershed management are summarized.
W81-00082

EVALUATION OF MEMBRANE FILTER METHODS FOR ENUMERATION OF FAECAL COLIFORMS FROM MARINE WATER,
Massachusetts Univ., Waltham. Dept. of Environmental Sciences.
B. L. Green, W. Litsky, and K. J. Sladek.
Marine Environmental Research, Vol 3, No 4, p 267-276, September, 1980. 3 Fig, 3 Tab, 14 Ref.

Descriptors: *Membrane processes, *Filters, *Coliforms, *Sea water, Incubation, Temperature, Water sampling, Sewage bacteria, Analytical techniques, Coasts, Sewage disposal, Laboratory tests.

A 24-hr modified membrane filter technique suitable for the enumeration of fecal coliforms from chlorinated sewage effluents employs m-FC agar with a preincubation temperature of 35C for 5 hr followed by 44.5C for 18 plus or minus 1 hr. The technique was compared with the standard membrane filter process with an incubation temperature of 44.5C and the most probable number (MPN) technique for estuarine and marine environments. The study used 9 laboratory and 72 plant chlorinated primary and secondary sewage samples. Comparison of the results of the techniques demonstrated that the modified membrane filter counts were higher than the standard membrane filter technique in 64 of 68 trials, with the modified method yielding an average of 50% higher counts than the standard membrane filter method. While both membrane filter methods had correlation coefficients of 0.95 compared with the MPN, only 75% of the standard membrane filter samples were within the 95% confidence limits of the MPN, whereas 90% of the counts obtained with the modified method fell within 95% confidence limits. (Lisk-FRC)
W81-00219

COMPUTER-BASED TELECONTROL FOR BROMLEY GROUP,
For primary bibliographic entry see Field 8C.
W81-00236

APPLICATIONS OF GEOPHYSICS IN GROUNDWATER INVESTIGATIONS,
Birmingham Univ. (England).
R. D. Barker.
Water Services, Vol 84, No 1014, p 489-492, 480, August, 1980. 9 Fig, 4 Ref.

Descriptors: *Groundwater, *Subsurface mapping, *Hydrogeology, *Instrumentation, Borehole geophysics, Geophysics, Aquifers, Saline water, Valleys, Resistivity, Gravimetry, Seismographs.

The use of geophysical techniques in investigating the condition of groundwaters is described. The electrical resistivity technique has particular advantages in hydrogeology in that it responds to variations in conductivity of the groundwater. This technique allows the land itself to remain undamaged. The gravity method is usually employed for reconnaissance purposes, particularly for locating faulted and other structural boundaries and for mapping of alluvium filled valleys. The seismic technique may be used to determine the depth to the base of alluvium. Induced polarization is used in hydrogeological surveys to distinguish between pure sands of high permeability and sands with disseminated clays of lower permeability. Four case histories are presented, three of which discuss the use of the resistivity technique. One case discusses the mapping of an aquifer structure. The second case describes the use of geophysical surveys to site a single borehole accurately. The third problem called for identification of the extent of the saline groundwater in a particular area and study of the subdrift geology and positions of major faults. The fourth case involves investigation of a buried drift-filled valley in Essex, England. (Baker-FRC)
W81-00237

PORTABLE INSTRUMENTATION TO MONITOR FLOW RATE AND VOLUME,
Georgia Univ., Athens.
R. Harrell, J. M. Allison, B. D. McLendon, and M. Lawrence.
Agricultural Engineering, Vol 61 No 5, p 12-13, May, 1980. 1 Fig.

Descriptors: *Flowmeters, *Monitoring, *Flow measurement, *On site data collection, Flow, Flow rates, Spraying, Volume, Velocity, Water measurement.

A description is given of a portable instrument designed to monitor flow rate and volume. The combination of display multiplexing and Complementary Metal Oxide Semiconductor (CMOS) Integrated Circuits makes battery operation of the circuit feasible, so that the system is portable. The display can be turned off and on without interrupting count operations, thus extending battery life. A panel switch makes it possible to reset the accumulator to zero. The device may be used in water flow systems, but could be equally well applied to measure air speed, revolutions per minute, ground speed, and other variables. It might also prove useful in measuring from sprayer applications where both flow rate and total volume are of interest. (Baker-FRC)
W81-00240

7C. Evaluation, Processing and Publication

HYDROLOGIC SETTING OF WILLIAMS LAKE, HUBBARD COUNTY, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2H.
W81-00050

THE U.S. GEOLOGICAL SURVEY IN ALASKA, 1980 PROGRAMS,
Geological Survey, Anchorage, AK. Water Resources Div.
Geological Survey Circular 823-A, 1980. 112 p, 23 Fig, 4 Tab, (Reed, K. M., editor).

Descriptors: *Alaska, Projects, *Natural resources, *Research and development, Energy, Mineralogy, Topographic mapping, Geology, Water resources, Investigations, Conservation, Oil, *U. S. Geological Survey, *Outer Continental shelf, National Petroleum Reserve in Alaska, *Federal reservations, Indian reservations.

This circular describes the 1980 programs of the U.S. Geological Survey in Alaska. A brief description of the Alaskan operations of each major division of the Survey is followed by project descriptions arranged by geographic regions in which the work takes place. The mission of the Geological Survey is to identify the Nation's land, water, energy, and mineral resources; to classify federally-owned mineral lands and waterpower sites; to resolve the exploration and development of energy and natural resources on Federal and Indian lands; and to explore and appraise the petroleum potential of the National Petroleum Reserve in Alaska. Alaska is at once the largest, the least populated, the least explored, and the least developed State in the Nation. More than half of the Nation's 600 million acres of Outer Continental Shelf lies off Alaska's coast. The land area of Alaska contains 375 million acres, 16 percent of the onshore land of the Nation. Its resources of all kinds present an opportunity to demonstrate how the needs of both conservation and development can be met for the benefit of the American people. (USGS)
W81-00051

SURFICIAL GEOLOGY OF PENNELLVILLE QUADRANGLE, OSWEGO COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
T. S. Miller.
Available from OFSS, Box 25425, Fed. Ctr., Denver, CO. 80225, Paper copy $2.00, Microfiche $4.00. Geological Survey Open-File Report 80-411 (WRI), 1980. 1 Sheet.

Descriptors: *Geology, *Glacial aquifers, *Groundwater potential, *Natural resources,

*New York, Water wells, Water yield, Maps, *Oswego County(NY).

The location and extent of 10 kinds of surficial deposits in Pennellville quadrangle, Oswego County, N.Y., are mapped on a 7.5-minute U.S. Geological Survey topographic map. The map was compiled to indicate the lithology and potential for ground-water development at any specific location. (USGS)
W81-00055

PRELIMINARY BATHYMETRY OF MC CARTY FIORD AND NEOGLACIAL CHANGES OF MC CARTY GLACIER, ALASKA,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2C.
W81-00056

PRELIMINARY BATHYMETRY OF AIALAK BAY AND NEOGLACIAL CHANGES OF AIALIK AND PEDERSON GLACIERS, ALASKA,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2C.
W81-00057

WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1979--VOLUME 3, OHIO RIVER AND ST. LAWRENCE RIVER BASINS,
Geological Survey, Harrisburg, PA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-223951, Price codes: A17 in paper copy, A01 in microfiche. Geological Survey Water-Data Report PA-79-3, June 1980. 386 p, 7 Fig.

Descriptors: *Pennsylvania, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Ohio River basin(PA), St. Lawrence River basin(PA).

Water resources data for the 1979 water year for Pennsylvania consist of records of discharge and water quality of streams; contents of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 86 gaging stations, contents at 22 lakes and reservoirs, water quality at 28 gaging stations and 11 wells, and water levels at 23 observation wells. Also included are data for 11 crest-stage, 28 low-flow, and 312 water-quality partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in volumes 1 and 2 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Pennsylvania. (USGS)
W81-00061

WATER RESOURCES DATA FOR SOUTH CAROLINA, WATER YEAR 1979,
Geological Survey, Columbia, SC. Water Resources Div.
Geological Survey Water-Data Report SC-79-1, June 1980. 302 p, 5 Fig.

Descriptors: *South Carolina, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1979 water year for South Carolina consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 57 gaging stations, stage-only records for 1 gaging station, stage and contents for 11 lakes and reservoirs, water quality for 25 gaging stations and 5 ungaged stations, and water levels for 23 observation wells. Also included are 46 crest-stage partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in South Carolina. (USGS)
W81-00062

WATER RESOURCES DATA FOR ILLINOIS, WATER YEAR 1979--VOLUME 2. ILLINOIS RIVER BASIN,
Geological Survey, Champaign, IL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-205230, Price codes: A18 in paper copy, A01 in microfiche. Geological Survey Water-Data Report IL-79-2, May 1980. 401 p, 4 Fig.

Descriptors: *Illinois, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Illinois River basin.

Water resources data for the 1979 water year for Illinois consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 85 gaging stations, stage only at 2 gaging stations, stage only at 3 lake stations, water quality at 92 gaging stations and 25 wells, and water levels at 3 observation wells. Also included are data for 96 crest-stage partial-record stations and 42 flood-profile stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in volume 1 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Illinois. (USGS)
W81-00063

AN ECOLOGICAL CHARACTERIZATION OF THE PACIFIC NORTHWEST COASTAL REGION. VOLUME 1. CONCEPTUAL MODEL,
Ryckman, Edgerley, Tomlinson and Associates, Inc., Bellevue, WA.
C. M. Proctor, J. C. Garcia, D. V. Galvin, T. Joyner, and G. C. Lewis.
Department of the Interior Fish and Wildlife Service Publication FWS/OBS-79/11, July 1980. 224 p, 96 Fig, 22 Tab, 186 Ref. 14-16-0009-77-019.

Descriptors: *Computer models, *Ecological distribution, *Environment, *Habitats, *Coasts, Data collections, Information exchange, Computer simulation, Data processing, Mathematical models, Programs(Computer), Simulation analysis, Model studies, Experimental models, Statistical models, Ecology, Ecosystems, Distribution, Balances of nature, Environmental gradient, Microenvironment, Basic data collections, *Pacific Northwest U.S.

A conceptual model was developed as the approach to ecological characterization of the Pacific Northwest Coastal Region, and used as a framework for collection, organization, and synthesis of data for the Characterization Atlas (Volumes 2-4). Model development was an iterative process, ranging from a 1977 Pilot Study Report and monthly Reports, to drafts of the Conceptual Model. Earlier drafts were used in preparing parts of the Test Characterization (Pilot Study), and the Model was modified following application to data collection to adjust for conceptual deficiencies. It was retested in characterization, with process reiteration, to yield the resultant Conceptual Model. This Model and the ecological models and submodels within it proved to be an integral framework for preparing the Characterization Atlas starting in Volume 2. It was concluded that the model approach for providing a conceptual framework for preparation and evaluation of ecological characterization studies represented a valid concept. Future work should involve further model modification/refinement as experience in application to natural systems is gained; and integration of the conceptual approach with mathematical modeling. Ecological modeling (Part 1) included specific considerations of the physiochemical, biological, and socioeconomic environments. Parts 2 and 3 respectively, considered specific zones/habitats and provided reference data. (Zielinski-IPA)
W81-00094

AN ECOLOGICAL CHARACTERIZATION OF THE PACIFIC NORTHWEST COASTAL REGION. VOLUME 2. CHARACTERIZATION--ATLAS REGIONAL SYNOPSIS,
Ryckman, Edgerley, Tomlinson and Associates, Inc., Bellevue, WA.
C. M. Proctor, J. C. Garcia, D. V. Galvin, G. C. Lewis, and L. C. Loehr.
Department of the Interior Fish and Wildlife Service Publication FWS/OBS-79/12, July 1980. 570 p, 165 Fig, 194 Tab, 820 Ref. 14-16-0009-77-019.

Descriptors: Data collections, Information exchange, *Computer models, *Ecological distribution, *Habitats, *Environment, *Coasts, Computer simulation, Data processing, Mathematical models, Programs(Computer), Simulation analysis, Model studies, Experimental models, Statistical models, Ecology, Ecosystems, Distribution, Balance of nature, Environmental gradient, Microenvironment, Basic data collections, *Pacific Northwest U.S.

Following completion of the Pilot Study reported in 1977, it became evident that use of a reporting structure, in which the Conceptual Model (Vol. 1) was to contain considerable regional data plus zone/habitat descriptions and habitat-specific models, was unsatisfactory for two reasons: (1) the physical bulk of material for the Conceptual Model was prohibitive; (2) more importantly, much material in the 1977 Conceptual Model really belonged in this Characterization Atlas. Thus, the reports structure was changed to that described in this Volume. This Regional Synopsis of the Characterization Atlas (Volume 2) contains a users' guide to access the characterizational information, and is comprised of three principal parts. Part I compiles regional characterizational information, covering the detailed features of the physical, biological, and socioeconomic environments of the coastal ecosystem. Part II reports on species of concern for twenty types of vegetative and land-based and marine animal species; while Part III contains reference data on symbols and terms. Volumes 3 and 4 of this ecological characterization deal with zone and habitat, and watershed descriptions, respectively; Volume 5 represents the data source appendix, containing data tapes and printouts. (Zielinski-IPA)
W81-00095

PRELIMINARY BATHYMETRY--ESTHER PASSAGE AND CHANNELS EAST TO EAGLEK ISLAND, ALASKA,
Geological Survey, Tacoma, WA. Water Resources Div.
A. Post.
Geological Survey Open-File Report 80-426, 1980. 1 Sheet.

Descriptors: *Bathymetry, *Coasts, *Alaska, *Hydrography, *Navigation, Depth, Rocks, Hazards, Sounding, *Esther Passage(Alaska).

A map, scale 1:20,000, shows water depths, rocks, and hazards to navigation. These data are noted on track lines run by the Research Vessel Growler in Alaskan waters, where data on navigation shown on published charts are nonexistant, preliminary, or out dated. (USGS)
W81-00137

PRELIMINARY BATHYMETRY OF BLACKSTONE BAY AND NEOGLACIAL CHANGES OF BLACKSTONE GLACIERS, ALASKA,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2C.
W81-00138

PRELIMINARY BATHYMETRY--APPROACHES TO UNAKWIK INLET, ALASKA,
Geological Survey, Tacoma, WA. Water Resources Div.
A. Post.
Geological Survey Open-File Report 80-428, 1980. 1 Sheet.

Descriptors: *Bathymetry, *Coasts, *Alaska, *Hydrography, *Navigation, Depth, Rocks, Hazards, Sounding, *Unakwik Inlet(Alaska).

A map, scale 1:20,000, shows water depths, rocks, and hazards to navigation. These data are noted on track lines run by the Research Vessel Growler in Alaskan waters, where data on navigation shown on published charts are nonexistant, preliminary, or out dated. (USGS)
W81-00139

PRELIMINARY BATHYMETRY OF NORTHWESTERN FIORD AND NEOGLACIAL CHANGES OF NORTHWESTERN GLACIER, ALASKA,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2C.
W81-00140

POTENTIOMETRIC SURFACE OF FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT AND ADJACENT AREAS, MAY 1979,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W81-00141

SEASONAL AND ANNUAL VARIATIONS IN THE POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN DUVAL COUNTY, FLORIDA, 1960-77,
Geological Survey, Tallahassee, FL. Water Resources Div.
G. W. Leve.
ogical Survey Open-File Report 80-164 (WRI), 1980. 1 Sheet, 4 Fig, 2 Ref.

Descriptors: *Maps, *Aquifers, *Water levels, *Potentiometric level, *Florida, Groundwater, Water utilization, Water wells, Water level fluctuations, *Floridan aquifer, *Duval County(FL), *Jacksonville(FL).

Potentiometric levels of the Floridan aquifer in Duval County, Fla., are constantly changing in response to gains of water to the aquifer, primarily by recharge from rainfall; and losses from the aquifer, primarily by withdrawals from hundreds of wells. Seasonal variations of the potentiometric level in one well at Jacksonville was 4.2 feet during 1976. During the 18 year period from 1960 to 1977 the mean annual decline of potentiometric levels in the county was about 8 feet because of a large increase in withdrawals and to a lesser extent a decline in average annual rainfall in recharge areas. Maps of the potentiometric surface in 1960 and 1977 indicate that the greatest decline was more than 20 feet in the south-central part of the county. The decline was less than 5 feet in the western part of the county. (Kosco-USGS)
W81-00142

GROUND WATER IN OSCEOLA COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. M. Frazee, Jr.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, paper copy $3.50, microfiche $0.50. Geological Survey Open-File Report 79-1595 (WRI), 1980. 1 Sheet, 6 Fig, 11 Ref.

Descriptors: *Maps, *Groundwater, *Aquifers, *Water quality, *Florida, Aquifer characteristics, Natural recharge, Potentiometric level, Water wells, Water levels, Water supply, Geologic formations, Hydrogeology, Hydrographs, *Osceola County(FL), *Floridan aquifer.

This report describes the ground-water resources of Osceola County, Florida, with emphasis on the (1) location of the principal aquifers, (2) location of areas of ground-water recharge and discharge, (3) chemical quality of ground water, and (4) quantities of ground water available. The investigation includes an inventory of 365 wells, test drilling in unconsolidated materials overlying the Floridan aquifer, water-level measurements, and water quality sampling and analysis. (USGS)
W81-00143

CONFIGURATION OF THE TOP OF THE HIGHLY PERMEABLE DOLOMITE ZONE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,
Geological Survey, Tallahassee, FL. Water Resources Div.
R. M. Wolansky, G. L. Barr, and R. M. Spechler.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, paper copy $1.75, microfiche $0.50. Geological Survey Open-File Report 80-433 (WRI), 1980. 1 Sheet, 24 Ref.

Descriptors: *Maps, *Aquifers, *Permeability, *Florida, Aquifer characteristics, Rock properties, Hydrogeology, Geohydrologic units, *Floridan aquifer, *Southwest Florida Water Management.

This map report presents the configuration of the top of the highly permeable dolomite zone of the Floridan aquifer in the Southwest Florida Water Management District. The top of the highly permeable dolomite generally corresponds to the top of a thick bed of massive, hard, dark brown dolomite occurring in the Avon Park Limestone of Eocene age. The altitude of the top of the permeable dolomite varies from about 100 feet below the National Geodetic Vertical Datum of 1929 in the north to about 1,600 feet below the datum in the south. (Kosco-USGS)
W81-00144

WATER RESOURCES DATA FOR OHIO, WATER YEAR 1979--VOLUME 1. OHIO RIVER BASIN,
Geological Survey, Columbus, OH. Water Resources Div.
Geological Survey Water-Data Report OH-79-1, July 1980. 487 p, 2 Fig.

Descriptors: *Ohio, *Hydrlogic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Ohio River basin(OH).

Water resources data for the 1979 water year for Ohio consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report in three volumes contains records for water discharge at 197 gaging stations, stage and contents at 32 lakes and reservoirs, water quality at 54 gaging stations and 49 wells, and water levels at 157 observation wells. Also included are data for 58 crest-stage partial-record stations, 26 low-flow partial-record stations, and 311 coal hydrology synoptic sites. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Ohio. (USGS)
W81-00145

WATER RESOURCES DATA FOR OHIO, WATER YEAR 1979--VOLUME 2. ST. LAWRENCE RIVER BASIN,
Geological Survey, Columbus, OH. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-105397, Price codes: A09 in paper copy, A01 in microfiche. Geological Survey Water-Data Report OH-79-2, June 1980. 183 p, 2 Fig.

Descriptors: *Ohio, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *St. Lawrence River basin(OH).

Water resources data for the 1979 water year for Ohio consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report in three volumes contains records for water discharge at 197 gaging stations, stage and contents at 32 lakes and reservoirs, water quality at 54 gaging stations and 49 wells, and water levels at 157 observation wells. Also included are data for 58 crest-stage partial-record stations; 26 low-flow partial-record stations, and 311 coal hydrology synoptic sites. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Ohio. (USGS)
W81-00146

WATER RESOURCES DATA FOR OHIO, WATER YEAR 1979--VOLUME 3. COAL AREAS,
Geological Survey, Columbus, OH. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-105405, Price codes: A08 in paper copy, A01 in microfiche. Geological Survey Water-Data Report OH-79-3, July 1980. 160 p, 2 fig, 3 tab.

Descriptors: *Ohio, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis. Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Coal areas(OH).

Water resources data for the 1979 water year for Ohio consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report in three volumes contains records for water discharge at 197 gaging stations, stage and contents at 32 lakes and reservoirs, water quality at 54 gaging stations and 49 wells, and water levels at 157 observation wells. Also included are data for 58 crest-stage partial-record stations; 26 low-flow partial-record stations, and 311 coal hydrology synoptic sites. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Ohio. (USGS)
W81-00147

WATER RESOURCES DATA FOR HAWAII AND OTHER PACIFIC AREAS, WATER YEAR 1979--VOLUME 1. HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-115065, Price codes: A14 in paper copy, A01 in microfiche. Geological Survey Water-Data Report HI-79-1, June 1980. 296 p, 15 Fig, 1 Tab.

Descriptors: *Hawaii, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging

stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Volume 1 of water resources data for the 1979 water year for Hawaii and other Pacific areas consist of records of stage, discharge, and water quality of streams; and water levels and water quality in wells and springs. This report contains discharge records for 111 gaging stations; water quality for 12 gaging stations, 103 partial-record flow stations, and 157 wells; and water levels for 22 observation wells. Also included are 106 crest-stage partial-record stations and 18 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, Federal, and other agencies in Hawaii. (USGS)
W81-00148

WATER RESOURCES DATA FOR HAWAII AND OTHER PACIFIC AREAS, WATER YEAR 1979--VOLUME 2. TRUST TERRITORY OF THE PACIFIC ISLANDS, GUAM, AMERICAN SAMOA, AND NORTHERN MARIANA ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
Geological Survey Water-Data Report HI-79-2, June 1980. 126 p, 14 Fig.

Descriptors: *Hawaii, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, *Mariana Islands, *Caroline Islands, *Samoa Islands.

Volume 2 of water resources data for the 1979 water year for other Pacific areas consist of records of stage, discharge, and water quality of streams; stage of a reservoir; and water levels in wells and springs. This report contains discharge records for 41 gaging stations, stage only record for 1 gaging station, water quality for 1 gaging station and 20 partial-record stations, water temperature for 42 gaging stations, water levels for 13 observation wells, tide level for 1 tide station, and 7 water level less tide level tables. Also included are 26 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating Governments and Federal agencies in other Pacific areas. (USGS)
W81-00149

MAPS SHOWING GROUND-WATER CONDITIONS IN THE DOUGLAS BASIN AREA, COCHISE COUNTY, ARIZONA--1978,
Geological Survey, Tucson, Az. Water Resources Div.
L. J. Mann, and C. S. English.
OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, paper copy $10.75, microfiche $1.50. Geological Survey Open-File Report 80-700 (WRI), May 1980. 3 Sheets, 11 Ref.

Descriptors: *MAPS, :GROUNDWATER, :Irrigation, *Water level fluctuations, *Water quality, Aquifer characteristics, Water wells, Withdrawal, Pumping, Drawdown, Land use , Hydrographs, Arizona, *Douglas basin area(AZ), *Cochise County(AZ).

The Douglas basin area includes about 1,200 square miles in southeastern Arizona. The main use of ground water is for irrigation. For 1955-77, the estimated ground-water pumpage equaled or exceeded 50,000 acre-feet per year, and for 1966-77, the ground-water pumpage averaged about 109,000 acre-feet per year. Ground-water withdrawals have resulted in water-level declines in most of the area. Information shown on the maps includes change in water level (1966-78) and irrigated area; depth to water and altitude of the water level; and chemical quality of the water and well depth. Hydrographs of the water level in selected wells and a table of historical pumpage also are included. Scale 1:125,000. (USGS)
W81-00155

MAPS SHOWING GROUND-WATER CONDITIONS IN THE UPPER VERDE RIVER AREA, YAVAPAI AND COCONINO COUNTIES, ARIZONA--1978,
Geological Survey, Tucson, Az. Water Resources Div.
G. W. Levings, and L. J. Mann.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, paper copy $9.50, microfiche $1.00. Geological Survey Open-File Report 80-726 (WRI), April 1980. 2 Sheets, 10 Ref.

Descriptors: *Maps, *Groundwater, *Aquifer characteristics, *Water table, *Water quality, Hydrogeology, Water supply, Water utilization, Water yield, Irrigation, Water wells, Water analysis, Fluorides, *Upper Verde River area(AZ), *Yavapai County(Az), Coconino County(AZ).

The upper Verde River area includes about 3,600 square miles in north-central Arizona. The area is underlain by a regional aquifer that consists of several formations. In places ground water also is present in the igneous rocks and basalt flows and in the alluvium along the channels and flood plains of the streams. Ground-water development has been slight; in 1978 about 8,000 acre-feet of ground water was withdrawn for domestic, public-supply, industrial, and irrigation uses. Information on the maps includes the principal geologic formation that furnishes water to wells and springs, depth to water, altitude of the water level, and chemical quality of the water. Scale 1:125,000. (USGS)
W81-00156

SHIFTING LEVEL MODELLING OF HYDROLOGIC SERIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W81-00207

8. ENGINEERING WORKS

8A. Structures

HYDRAULIC DESIGN OF BRIDGES WITH RISK ANALYSIS,
Geological Survey, NSTL Station, MS. Water Resources Div.
V. R. Schneider, and K. V. Wilson.
Federal Highway Administration report, FHWA-TS-80-226, March 1980. 138 p, 7 Fig, 3 Tab, 22 Ref, 2 Append. P O 5-3-0194.

Descriptors: *Hydraulic design, *Bridges, *Risks, *Analytical techniques, *Economic life, Design flood, Flood plains, Highway effects, Backwater, Flow profiles, Open channel flow, Channel morphology, Construction, Costs, Project planning, Design data, *Risk analysis.

This manual presents example studies and reports which implement the philosophy that the total stream crossing including the approach fills in the flood plains and all necessary waterway openings should be designed and constructed for the least total expected cost to the public. The total expected cost includes the capital investment in the highway, expected replacement and repair costs as a result of flood damages, expected user costs from traffic interruption and detour, and expected backwater drainages during the service life of the highway. Techniques for making engineering and economic studies for the least cost designs are presented along with suggestions for managing the time and work required for such studies. A unique design flood is defined for each bridge as the flood whose upstream stage is equal to the lowest elevation of the approach fill or bridge deck. Two example reports were prepared to illustrate the application of the method to a rural site (low backwater damage) and an urban site (high potential traffic interruption and backwater damage). (USGS)
W81-00054

DRAINAGE FOR AN INDUSTRY/OFFICE COMPLEX,
Halff (Albert H.) Associates, Inc., Dallas, TX.
For primary bibliographic entry see Field 4A.
W81-00211

OXFORD CITY GETS NEW TRUNK OUTFALL SEWER. WEDGE BLOCK TUNNEL SAVES CHRISTCHURCH MEADOWS AND 3 MILLION POUNDS,
Water Services, Vol 84, No 1014, p 507-508, 511-512, August, 1980. 3 Fig.

Descriptors: *Outfall sewers, *Tunnels, *Pumping plants, *Municipal wastes, *Sewerage, Sewers, Geological surveys, Underground structures, Costs, Social aspects, Water yield.

Use of a wedge-block lining technique to upgrade an overloaded sewer system for the City of Oxford, England, is described. The block tunnel was designed to replace the existing outfall sewer with a new low-level pumping station to lift the flow about 12 m from the tunnel outfall to the level of the existing inlet to the pretreatment plant. When this was completed, the plan called for a detailed survey of the existing brick-ring trunk sewer to determine whether it should be repaired or filled in. It was estimated that use of the wedge-block lining technique in this particular problem area allowed the savings of large amounts of money by the City. (Baker-FRC)
W81-00234

CLEANER TYNE.
For primary bibliographic entry see Field 5D.
W81-00239

8C. Hydraulic Machinery

COMPUTER-BASED TELECONTROL FOR BROMLEY GROUP,
Water Services, Vol 84, No 1014, p 495-496, August, 1980. 2 Fig.

Descriptors: *Pumping plants, *Control systems, *Computers, *Monitoring, *Instrumentation, Computer programs, Pumping, Pressure measuring instruments, Flow measurement, Flow rates, Distribution systems, Pipelines, Water conveyance, Reservoir storage.

Updating of the Bromley Area Water Pumping Scheme in England was conducted over a 4-year period. More modern equipment was added to older pumping stations and a control center was established at the Orpington station to house the new maintenance center that will service the Kent area. A large instrumentation console was built at the Shortlands station to monitor valve positions, pump currents, flows, pressure and levels. A micro-computer-based process controller was installed at the Orpington facility to check alarms on pressures, flows, chemical treatment/aeration tank operation and initiate corrective actions when faulty conditions occur. A computer-based telecontrol system was set up to supervise the rebuilt stations plus the West Wickham and Brasted stations based on the Type 1000 modular digital telemetry. The centralized scheme was programmed so that a fault anywhere in the system could not cause complete loss of monitoring and control. A separate recording panel was installed to allow continuous monitoring and a micro-computer system was added to process the data for future analysis and recording. Daily measurements could be obtained from two visual display terminal units (VDU) with a printer. Tracking of alarm locations from the VDU is described. A display in the control room shows by color codes which stage of water purification the system is handling. Other

control room displays and scalings are described. In the event of a computer control system failure, the controls may be actioned directly through the telemetry system. The use of computers has made the control of water a more precise art. (Geiger-FRC)
W81-00236

8I. Fisheries Engineering

NIGHTTIME AERATION TO INCREASE PRODUCTION OF CHANNEL CATFISH,
Auburn Univ., AL.
W. D. Hollerman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-111296, Price codes: A03 in paper copy, A01 in microfiche. MS thesis, 1980, 33 p, 6 Fig, 5 Tab. OWRT B-076-ALA (4), 14-34-0001-8001.

Descriptors: *Channel catfish, *Aeration, Dissolved oxygen, Economics, *Fish farming, *Ponds, Fish populations, Number of fish per acre, Water quality, Fish diseases, Fish production, Alabama.

Channel Catfish (Ictalurus punctatus) were stocked in 0.02- to 0.04- hectare ponds at 20,385 per hectare and fed daily. Fish averaged 11 cm total length and 6.2 g at stocking. Six ponds received daily nighttime aeration (2 to 6 hours) and six ponds received no aeration. A maximum feeding rate of 90 kg/hectare was reached by midsummer. In the aerated treatment, no dissolved oxygen (DO) problems occurred, and survival was 92%. Fish mortalities resulted from DO depletion in all ponds of the unaerated treatment, and survival was 40%. Nitrite-nitrogen concentrations were significantly higher in the aerated treatment, though never at levels reported as lethal to channel catfish. Concentrations of un-ionized ammonia in both treatments were high enough to have adversely affected growth. The aerated treatment produced an average 5,807 kg/hectare of channel catfish and had a net economic gain of $1,500 per hectare. The unaerated treatment produced an average 1,400 kg/hectare and was an obvious economic failure.
W81-00008

LIQUID AMMONIUM POLYPHOSPHATE AS A FISH POND FERTILIZER,
Auburn Univ., AL.
R. J. Metzger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-111288, Price codes: A03 in paper copy, A01 in microfiche. MS thesis, 1980, 30 p, 4 Fig, 3 Tab. OWRT B-076-ALA (5), 14-34-0001-9101.

Descriptors: *Sunfish, Ponds, *Fertilizers, *Fish farming, Costs, Evaluation, Fish populations, Number fish per acre, * Amonium phosphate, Fish production, Liquid ammonium phosphate.

Sunfish ponds were fertilized 11 times during the growing season with liquid ammonium polyphosphate (13-38-0) at 5.6, 11.2, or 22.4 kg hectare super -1 application super -1. Net production of sunfish averaged 310, 315, and 418 kg/hectare in the low, medium, and high treatments, respectively. Net production of the high treatment differed from net production of the other two treatments. These findings suggest that 5.6 kg hectare super -1 application super -1 of liquid ammonium polyphosphate is suitable fertilization for woodland ponds with low to moderate fishing. A rate of 22.4 kg hectare super -1 application super -1 is adequate in woodland ponds with heavy fishing. Uniform surface application was the most effective technique of applying liquid ammonium polyphosphate. Liquid ammonium polyphosphate fertilization would generally be cheaper than fertilization with conventional granular fertilizers.
W81-00009

THE USE OF PERIODIC LIGHT APPLICATIONS OF ROTENONE AS A MANAGEMENT TECHNIQUE FOR SMALL IMPOUNDMENTS,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 2H.
W81-00119

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

BIBLIOGRAPHY OF GEOLOGY AND HYDROLOGY, SOUTHWESTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
A. F. Wright.
Available from the National Technical Information Service, Springfield, VA 22161 as PB80-199961, Price codes: A12 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-20, January 1980. 255 p, 1 Fig.

Descriptors: *Bibliographies, *Geology, *Hydrology, *Natural resources, *New Mexico, Oil, Natural gas, Potash, Coals, Chemistry, Southwestern New Mexico.

The southwestern part of New Mexico is recognized as a source of abundant and varied natural resources. This bibliography of over 2,700 references concerned with geology, hydrology, chemistry, and geography has been compiled to assist physical science researchers in their study and development of this region. (USGS)
W81-00059

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